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Thirty-six-inch Tool Grinder.

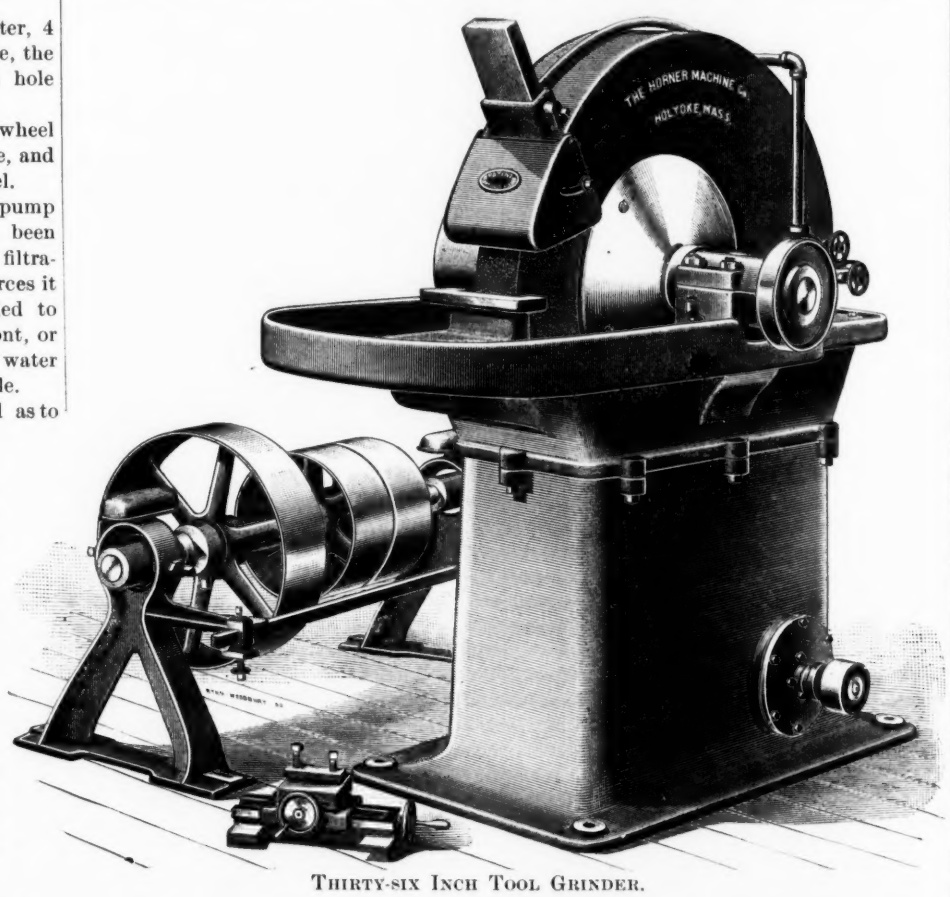
We give on this page an illustration of an improved tool grinder made by the Horner Machine Company, Holyoke, Mass.

Wheels up to 36 inches in diameter, 4 inches thick, are used on the machine, the collars being adapted for a 20-inch hole through the wheel.

The shield or hood which covers the wheel is made very substantial, is adjustable, and is used in supplying water to the wheel.

In the base of the machine is a pump which takes the water after it has been thoroughly cleansed by settlement and filtration in various receiving pans, and forces it up to the hood, where it may be applied to the wheel, either at the back or in front, or both, as may be desired, the supply of water being abundant and readily controllable.

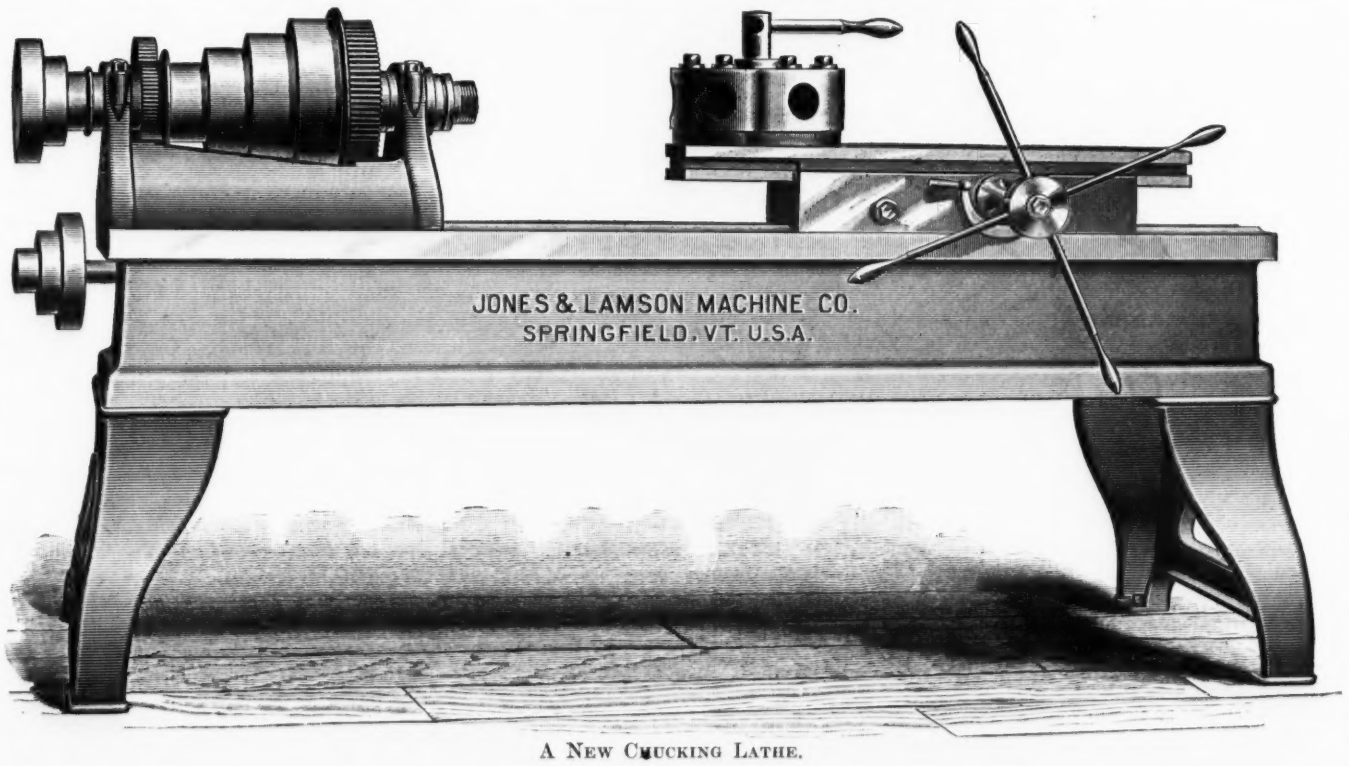
The inside of the hood is so formed as to catch and hold the water on the surface of the wheel, this and the water feeder together forming a reservoir in which the wheel runs. The piping is all metallic, and the pipe which passes over the hood is attached to it in such a manner that, when one union joint is broken, the pipe comes away with the hood. The front of the machine is rounded so that the workman stands at the same distance from it in any position. The tool rest shown in the engraving is furnished with each machine. The spindle is $2\frac{15}{16}$ inches diameter, and runs in long self-oiling boxes. The floor space occupied over all is 33 inches by 4 feet 10 inches.



THIRTY-SIX INCH TOOL GRINDER.

The statement that the "Teutonic," during her recent record-breaking trip across the ocean, burned something over 300 tons of coal per day, again suggests the great desirability of using oil as a fuel for the transatlantic vessels, as it undoubtedly would be used could its cost be brought down to something like that of coal. To say nothing of the fact that only about one-half the weight of oil would be necessary, a further great advantage would result from the fact that, with the fires once started at the beginning of a trip, they would continue to burn at a maximum until the end, and with an amount of attention which would be so small as compared with firing coal as to be scarcely worth noticing. Coal is probably safer than petroleum would be, but the methods of handling the oil are constantly being improved, and though comparative tests in steam making have shown the oil to be much the more costly, it is still being used for that purpose in some cases where coal is as readily obtainable as it usually is, and where it is not likely that oil would continue to be used at any very great loss to the user.

A traveler in Mexico says the natives are unwilling to adopt modern ways, and it is nearly impossible to make them change. An Englishman engaged in mining put up a hoisting plant, but found at once that it was money thrown away, as the workmen would not consent to its use. They had long been accustomed to carry the ore in sacks supported by a broad canvas band passing over their foreheads, and to receive so much for each sack delivered at the mouth of the shaft. To get it there, an ascent of over 200 feet had to be made by means of ladders, and accordingly progress was very slow. But nothing would induce them to use the hoisting machinery, and it had to be abandoned, every man working in the old fashion.



A NEW CHUCKING LATHE.

A New Chucking Lathe.

We illustrate on this page a new chucking lathe which has been brought out by the Jones & Lamson Co., of Springfield, Vt.

It is designated by the manufacturers as a 20x16-inch machine, from the fact that work 20 inches diameter can be swung in the chuck, while the working length of the turret slide, and consequently the depth of work that can be bored continuously, is 16 inches.

Being intended only for chucking, the expensive features of the more elaborate machines intended for general work are dispensed with, and only such features used as are necessary to the efficient performance of the particular functions connected with boring and chucking.

The head is plain back-geared. The turret is furnished with power feed and the same sensitive knock-off that is put on all their more elaborate machines which have been described in our columns from time to time. On top of the turret there is a lever which is used to bind the turret in place, and this lever is so arranged that when it is turned to release the turret it draws out the locking pin also at the same time, so that the turret is immediately ready to be turned forward or backward to any desired position (which in this machine is done by hand), after which the reverse motion of the lever throws in the locking pin, and again binds the turret. It will be seen that this double function of the lever saves two operations for each position of the turret, and of course will prove a great convenience as well as saving of time.

When desired, a cross-slide with tool-post and stops for gauging the movement of the slide is furnished, this being used for facing or similar work.

With the machine there is provided a rest for tool bushings, triple friction counter-shaft, and wrenches, etc. The hole through the spindle is 2 inches diameter; cone steps, 6, 8, 10 and 12 inches; belt width, 3 inches; length of bed, 100 inches; weight, 2,700 pounds.

It is reported that the Chinese government is looking into the matter of an improved shoulder arm for its troops, and that a commission from the emperor will soon visit England to examine and test guns with a view to the selection of the one which seems best adapted to their use. The commission, it is reported, will have instructions to especially examine into the merits of the Lee magazine rifle which is now used by the British troops, and to compare it with the guns

of the European armies. The Lee rifle is an American invention which has been adopted by the British army after the most thorough competitive tests with other arms, and it is thought that the Chinese officials having the report of the British officers on this trial before them will be very likely to adopt the gun. If so, then it is thought to be pretty certain that the guns will have to be made in this country, at Ilion, N. Y. It is expected that consignments of rifles will be required to begin within three months of the signing of the contract and that at least 500,000 rifles will be required.

The Chinese are reported as being interested also in light field batteries of rapid-fire guns and that there is an excellent chance of securing a large order for Hotchkiss guns, which will be made in this country, either at the shops of the Pratt & Whitney Co., or Colt's Armory, or both.

Engines for the U. S. Armored Cruiser "Maine."

The pair of triple-expansion engines for the U. S. cruiser "Maine," which have been in course of construction at the shops of the Quintard Iron Works, East 12th street, New York, have been completed and erected in the above shops. Previous to their shipment to the cruiser, they were exhibited, and an opportunity was given to engineers and invited guests interested in this class of work to inspect the engines. The high-pressure cylinders are 35½ inches diameter; intermediate cylinders, 57 inches diameter; and the low-pressure cylinders, 88 inches diameter; stroke of all the pistons, 36 inches. With a steam pressure of 135 pounds, and running at a rate of 132 revolutions per minute, the combined horse-power, including the auxiliary engines for working the air-pumps, etc., is rated at 9,000. None of the auxiliary engines, excepting those two which will be used for turning the main engines on board the ship when the latter have no steam, were exhibited. These small turning engines are of the simple upright type, and each has two cylinders 6 inches diameter and 8 inches stroke. To make the exhibition interesting, steam was supplied to the turning engines and these furnished the power for running the larger ones up to about 17 turns per minute during the exhibit. This, of course, was no test for the large engines, as has been erroneously stated in some of the daily papers; all it really did show was, that the engines were in proper alignment, with sufficient clearance allowed in the mechanism so that the moving parts would not interfere with each other, and that everything worked very smoothly and satisfactorily. If our casual observation is not at fault, great credit is due to the designer, Engineer-in-Chief Geo. W. Melville, U. S. N., for the general design and excellent proportions of the different parts of the engines; and congratulations are due to the builders for the excellent manner in which they have done their work. There is little doubt but that these engines will give as good an account of themselves when they are put to a test on the cruiser, as they appeared to do in the shops of the builders.

Compound Engines.

BY JAMES TRIBE.

THIRD PAPER.

NON-CONDENSING COMPOUNDS.

The condensing compound is not under all circumstances the most economical type of engine.

It is well known that about 20 feet lift and 500 feet of pipe should be regarded as the limit for distance through which the supply of water for condensing purposes should be drawn by the vacuum of the condenser; and it may be impossible to locate the engine within this limit. Then the question arises: What can be done, to be the most satisfactory under the circumstances? Suppose the distance of the water supply exceeds 500 feet, but let the levels be favorable, that is to say, not more than 15 feet from the surface of the water to the inlet of the condenser. Here the water can be made to flow into the neighborhood of the condenser by gravitation, through pipes, not necessarily strictly air-tight, and to discharge into a well made for that purpose. Then to furnish the injection pipe with a foot valve on the lower end, and suspend it in the center of the well, some 12 inches or more from the bottom, and covered by 3 or 4 feet of water, is far better than attempting to draw the water by suction through so great a distance, with the risk of losing the vacuum by leaky joints somewhere in such a length of pipe.

The chief objection to such an arrangement, however, would be the great expense in the excavation necessary for such a depth.

Next, suppose the water level to be unfavorable for such an arrangement as described above; then an auxiliary engine could be located somewhere near the supply, and the water pumped through pipes into the vicinity of the condenser. This likewise is objectionable from an economical standpoint, inasmuch as that small steam pumps are not usually of the most economical kind of steam machinery.

Or, again, it may be required to furnish large quantities of exhaust steam, of say a half pound pressure or more above the atmosphere, for purposes outside of the engine. In such a case also the condensing engine would not be admissible.

These or some other of the many difficulties may be in the way, and the only alternative then is to adopt the non-condensing engine, which, however, if compound, and of good proportions, would be far more economical than a single-cylinder non-condensing.

Let us consider, then, that we are contemplating the design and proportions of a non-condensing compound engine.

The first question is that of the steam pressure to which we may be limited, and, as was seen in the second paper, the economy will depend largely upon the higher pressure.

In the first place a non-condensing engine must expand at a pressure at least a little above the atmosphere, say half a pound per square inch or so, so as to overcome any frictional resistance in the exhaust passages and pipes, or the back pressure valve, which may be placed at the end of the line.

Of course, the atmospheric pressure, compared with the steam gauge, will depend upon the altitude; but assuming that it is equal to 15 pounds absolute per square inch, and then, as above, allow for frictional resistance ½ pound per square inch. Then the terminal pressure must not fall below 15.5 pounds, which we assume to be equal to the back pressure, or otherwise a loop will appear on the indicator card at the lower end of the expansion line, indicating an objection.

If, then, we have 15.5 as terminal pressure, and the engine contemplated is a two-cylinder compound, we ought to expect at least nine expansions, or as many as twelve, providing the steam can be raised to an initial pressure equivalent to it, which can be determined by Rule 3, thus:

Initial pressure in absolute pounds per square inch.

Rule 3.—Terminal pressure multiplied by the number of expansions.

1st.—Then for 9 expansions, and 15.5 pounds terminal pressure, we have $9 \times 15.5 = 139.5$ pounds absolute, or 139.5 less 15 = 124.5 gauge.

2d.—For 12 expansions, and 15.5 pounds terminal pressure, we have $12 \times 15.5 = 186$ pounds absolute, or 186 less 15 = 171 pounds gauge; to this add say 4 pounds for loss by condensation.

The above rule can, of course, be applied for any number of expansions, and any terminal pressure.

NOTE.—In dealing with the laws of expanding steam always figure the pressures in absolute pounds, and not pounds above the atmosphere, as recorded by the steam gauge. Serious errors have been made by the oversight of this fact.

We will now work out one example, which, if followed closely in the order used, will help in figuring others under different conditions.

Example.—Required, the diameters of cylinders for a 500 horse-power two-cylinder compound non-condensing engine.

Assuming steam pressure 175 pounds above atmosphere.

Back pressure ¼ pound above atmosphere.

Piston speed 480 feet per minute.

Deal with the high pressure first, then with the low, following step by step in the following order:

HIGH PRESSURE.

1st.—Find total number of expansions.

Rule 1.—Steam pressure, absolute, divided by terminal pressure in low-pressure cylinder.

175 + 15 = 190 pounds absolute.

190 ÷ 15.5 = 12.2 minus loss = 11.9 expansions.

2d.—Find number of expansions in each cylinder.

Rule 2.—Extract the square root of total expansion.

11.9 total expansions.

$\sqrt{11.9} = 3.45$ expansions in each cylinder.

3d—Find forward pressure per square inch.

Rule 4.—Initial pressure, multiplied by hyp. log. of expansions + 1, and divide by number of expansions.

Hyp. log. 3.45 = 1.238.

Hyp. log. + 1 = 2.238.

$$\frac{190 \times 2.238}{3.45} = 123.2.$$

4th.—Find back pressure per square inch. Back pressure should equal terminal pressure.

Rule 5.—Initial pressure divided by number of expansions:

190 ÷ 3.45 = 55 pounds.

5th.—Find mean effective pressure per square inch.

Rule 6.—Forward pressure, minus back pressure:

123.2 — 55 = 68.2 pounds.

6th.—Find effective area of piston.

Rule 7.—Total foot-pounds, divided by the product of piston speed in feet per minute multiplied by mean effective pressure.

NOTE.—The work in each cylinder should be equal, viz., 250 horse power each:

$\therefore$ 250 × 33,000 = 8,250,000 foot-pounds.

Piston speed by mean effective pressure by effective area.

480 × 68.2 by effective area.

$$\therefore \frac{8,250,000}{480 \times 68.2} = 252 \text{ square inches.}$$

7th.—Find diameter of cylinder.

Rule 8.—Extract square root of effective area of piston plus half area of rod, divided by .7854.

NOTE.—Assume half area of rod as eight square inches.

252 + 8 = 260 square inches area.

$$\sqrt{\frac{260}{.7854}} = 18.2 \text{ diameter.}$$

LOW PRESSURE.

8th.—Find initial pressure in pounds absolute.

Rule 9.—Terminal pressure in high-pressure cylinder.

NOTE.—Assume that receiver is well protected. Initial pressure equals 55 pounds.

9th.—Find mean forward pressure.

Rule 4.—Initial pressure, multiplied by hyp. log. of expansion plus 1, and divide by number of expansions.

$\therefore$ Hyp. log. of 3.45 = 1.238.

Hyp. log. + 1 = 2.238.

$$\frac{55 \times 2.238}{3.45} = 35.7 \text{ pounds per sq. inch.}$$

10th.—Find terminal and back pressure.

Rule 5.—Initial pressure, divided by number of expansions, minus loss by condensation, 55 ÷ 3.45 = 15.9 less .4 = 15.5 back pressure.

11th.—Find mean effective pressure.

Rule 6.—Forward pressure, minus back pressure, 35.7 — 15.5 = 20.2 pounds.

12th.—Find effective area of piston.

Rule 7.—Total foot-pounds, divided by the product of piston speed in feet per minute, multiplied by mean effective pressure.

NOTE.—This cylinder also to develop 250 H. P.; 250 × 33,000 = 8,250,000 foot-pounds. Piston speed by mean effective pressure by effective area, viz., 480 × 20.2 by effective area:

$$\frac{8,250,000}{480 \times 20.2} = 851 \text{ square inches.}$$

13th. Find diameter of cylinder.

Rule 8.—Extract square root of effective area of piston plus half area of rod divided by .7854.

NOTE.—Assume half area of rod as 12 square inches; 851 + 12 = 863 square inches area.

$$\sqrt{\frac{863}{.7854}} = \sqrt{1,099} = 33.15 \text{ diameter.}$$

Collecting the results of the above calculation together, we have:

HIGH PRESSURE.	LOW PRESSURE.
Effective area of piston = 252 square inches.	Effective area of piston = 851 square inches.
Speed of piston = 480 feet per minute.	Speed of piston = 480 feet per minute.
Mean effective pressure per sq. in. = 68.2 pounds.	Mean effective pressure per square inch = 20.2.
$\frac{252 \times 480 \times 68.2}{33,000} = 250$ H. P.	$\frac{851 \times 480 \times 20.2}{33,000} = 250$ H. P.

TABLE 4.

TWO-CYLINDER COMPOUND

NON-CONDENSING.

Back Pressure One-half Pound Above Atmosphere.

Steam pressure above atmosphere	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175
Initial absolute pressure	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190
Total expansion	7.39	7.56	7.84	8.12	8.41	8.7	9	9.3	9 61	9.92	10.24	10 56	10.89	11.22	11.56	11.9
Expansions in each cylinder	2.7	2.75	2.8	2.85	2 9	2.95	3	3.05	3.10	3.15	3.2	3 25	3.3	3.35	3.4	3.45
Hyp. log. plus 1	1.993	2 011	2 029	2.047	2.064	2 081	2.098	2 115	2 131	2.147	2 163	2.178	2.193	2.209	2.223	2.238
Forward pressures	High	84.8	87.7	90.5	93 3	96	98.7	101 4	104	106.5	109	111.5	113.9	116.3	118.7	120.9	123 2
	Low	31.3	31.8	32.3	32.7	33.1	33.4	33.7	34	34 3	34 6	34 8	35	35.2	35.4	35 6	35.7
Back pressures	High	42.5	43 6	44 6	45 6	46.5	47.4	48 3	49 1	50	50.7	51.5	52 3	53	53.7	54.4	55
	Low	15 5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15 5	15.5	15 5	15.5	15.5	15.5	15.5	15.5
Mean effective pressures	High	42.3	44 1	45.9	47.7	49.5	51.3	53.1	54 9	56.5	58.3	60	61.6	63.3	65	66.5	68 2
	Low	15.8	16 3	16.8	17.2	17 6	17.9	18.2	18 5	18.8	19.1	19.3	19.5	19 7	19.9	20.1	20.2
Ratio cylinder areas	2 67	2.7	2 73	2.77	2.81	2.86	2 91	2.96	3	3.06	3.11	3.16	3.21	3.26	3 31	3.37

Table 4 is arranged to assist in finding the proper proportions of non-condensing compound engines for various steam pressures, ranging from 100 pounds to 175 pounds above the atmosphere. For instance, by the use of these figures the areas of the cylinders for any given horse-power can be readily obtained.

Example 2. Find the area of each cylinder for a 200 H. P. engine. Piston speed 400 feet per minute, and steam 130 pounds gauge.

High Press. { M. E. Press. under column for 130 lbs. = 53.1, then $\frac{33,000 \times 100}{53.1 \times 400}$ = 155.3 sq. in. area.

Low Press. { Ratio of area under 130 lbs. gauge = 2.91; then 155.3 × 2.91 = 452 sq. in. area.

The steamship "Etruria," while recently making the passage to this country, had her decks swept by a great wave, although the sea was comparatively smooth. It happened at a time when the passengers were in their berths, but it seriously injured several of the crew, one at least having since died of his injuries. When the passengers learned of the accident they subscribed fifteen hundred dollars for the injured men.

Improved Wood-working Machines.

On this page we give some illustrations of improved wood-working machinery recently brought out by the Cordesman Machine Company, of Cincinnati, Ohio. The first of these is a double cut-off saw, technically known as a bolt and stave equalizer. It is used for such work as cutting up the stock for barrel and cask staves or similar work up to 50 inches in length. As will be seen, the frame is of the A form, carrying the shaft at the top, on which there are two sleeves carrying the saws; these sleeves being adjustable to or from each other to any distance within the specified limit, *i. e.*, 50 inches. Pivoted near the bottom of the frame and in front is a swinging frame which is balanced by a weight at the back, and carries two rests which are also adjustable to any desired distance apart on the swinging frame. The work is placed in these rests and swung forward to the saws. The arbor is of steel, 2¼ inches diameter; is splined its entire length for driving the saws in any position, and runs in long, pivoted, self-oiling boxes. The saws are 23 inches diameter. The machine is substantially built, and, of course, is adapted to a large class of work in furniture factories, carriage and wagon shops, agricultural implement works, etc.

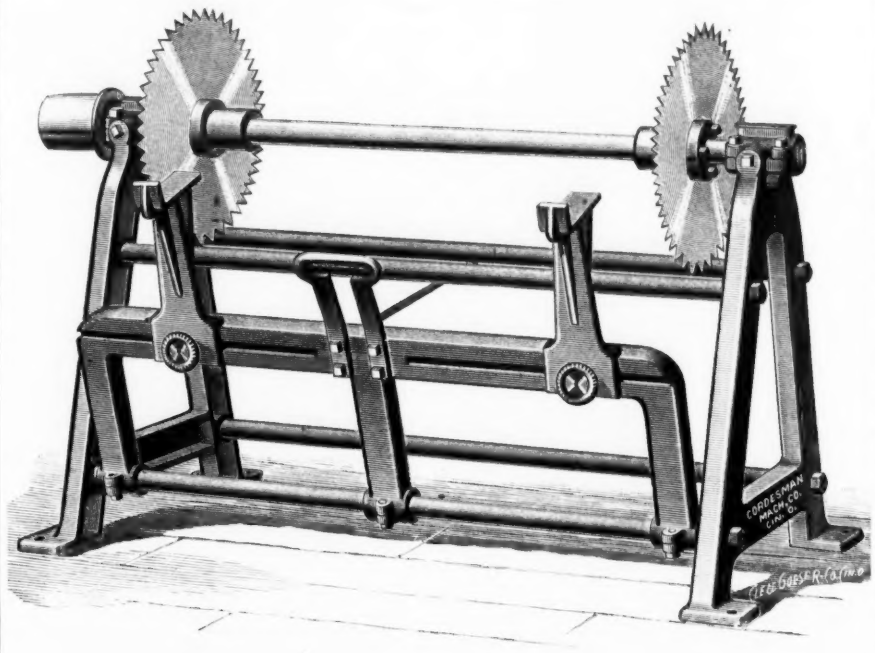
The second machine is a saw table having a frame of hard wood, mortised and bolted together, and finished with shellac varnish. The top is of strips of maple and beech glued together, and with cross-pieces fastened below. It is hinged at the back part of the frame, and is raised to any desired height by the screw and hand-wheel shown. It can be also clamped at any height by the clamps seen at the side of the machine.

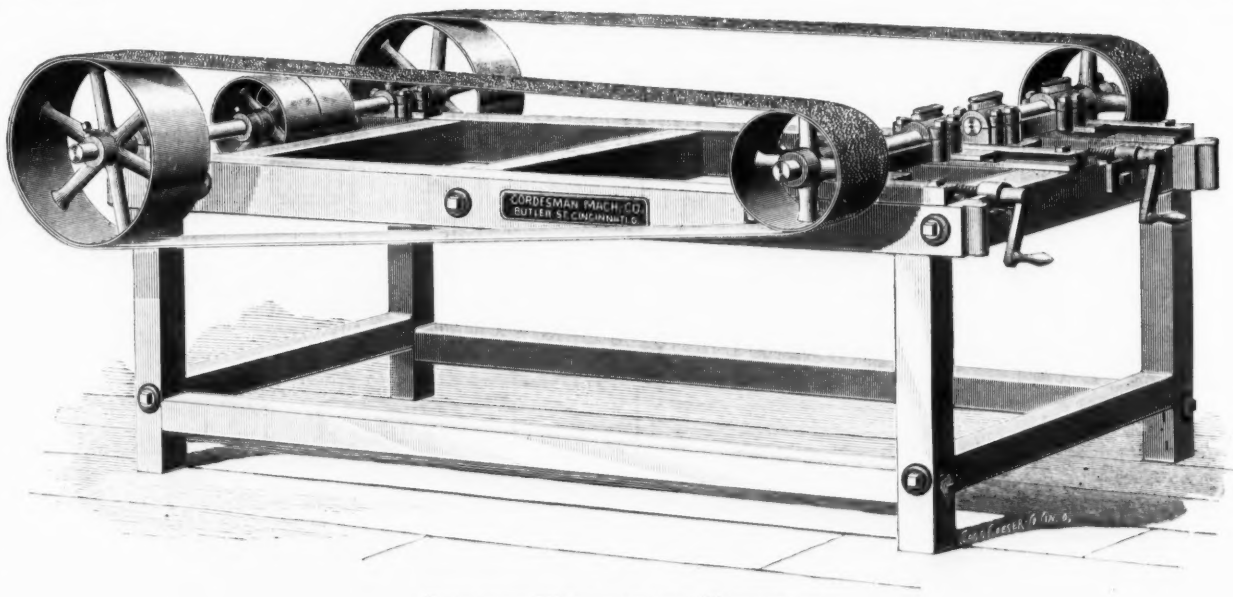
On the table is a fence which is adjustable up to 24 inches, there being a graduated rule for this, which indicates the setting at a glance.

The arbor is of steel, runs in long, self-oiling connected bearings with pulley either outside or between the bearings. There is an improved automatic expansion device on the arbor, whereby the saw is automatically centered, regardless of differences in size of the holes in the saws.

The machine is built, when desired, with a self-feeding attachment, which fastens to the top of the table, the stock being driven by a spur wheel which acts on that part of it which is afterwards removed by the saw. This attachment, when not in use, can be swung out of the way. This machine is built in six sizes, with tables from 29x48 inches to 38x78 inches, and other parts in proportion.

The third machine is what is known as a double sand belt machine, and is used in finishing spokes, neck yokes, wagon and carriage gearing, handles and other irregular forms of work. The frame is constructed of the same material and in the same manner as that described above. At one end of the frame is the driving shaft, which is supplied with tight and loose pulleys 10x5½ inches; the sand belt pulleys being outside the frame, so that belts may be readily changed. The tension pulleys are adjustable independently of each other by means of the screws and hand-cranks shown. Shafts are of steel, and run in self-oiling boxes.





IMPROVED WOOD-WORKING MACHINERY.

The Erie railroad has something like a dozen steam tugs in the vicinity of New York. These tugs are not only for the purpose of towing boats and floats, but they form a very efficient fire department. Their fire pumps are tested every few days, and every effort is made to keep them ready for sharp duty.

A Sawyer on Wings.

The bill of a mosquito is a complex institution. It has a blunt fork at the head and is apparently grooved. Working through the groove and projecting from the angle of the fork is a lance of perfect form, sharpened with a fine bevel. Beside it the most perfect lance looks like a hand-saw. On either side of the lance two saws are arranged, with the points fine and sharp and the teeth well defined and keen. The backs of these saws play against the lance.

When the mosquito alights with its peculiar hum, it thrusts its keen lance and then enlarges the aperture with the two saws which play beside the lance until the forked bill with its capillary arrangement for pumping the blood can be inserted. The sawing process is what grates upon the nerves of the victim and causes him to strike wildly at the sawyer.—*Journal of Health.*

The typewriter has hitherto been supposed to be an English invention, subsequently developed by the Americans; but a patent has been discovered in the French archives which gives the credit of originating the idea to a Frenchman, M. Pogrin, of Marseilles, who devised and illustrated his apparatus as far back as 1833. "With a little practice," says the author, "one can write as rapidly with the ktypographic pen as with the ordinary pen. I have called it the ktypographic machine or pen, because it prints by striking. It will give birth to a new art." Latest developments of the invention are a typewriter for the blind.—*Machinery.*

Whitworth's Quick Return and Jim Crow Planers.

BY C. W. CRAWFORD.

The device known as the Whitworth quick return is popularly believed to have originated at the works of Sir Joseph Whitworth, at Manchester, England. A recent visit to these works failed to disclose any tools having it on, but instead, all the large tools of the kind were operated by plain crank motion. However, the quick returns might have been up-stairs among the small tools.

There is one species of tool there that the old-time machinists have heard of, but few have ever seen—the Jim Crow planer. This tool was generally supposed to be a myth, or at least to have become extinct, but it is there doing excellent work. Some of them have two tool slides, and the turnabout motion is very graceful, and the tool falls into the cut as accurately as any other planer. The tool is a sort of diamond point, and evidently requires careful setting to cut equally both ways. The speed is the same both ways, and they are all screw planers, but, unlike the usual screw planer, they are almost noiseless. While these machines seem to be very good for surfacing, I think they are no good for general purposes.

All of the heavy machines and some light ones in Whitworth's, as well as in other shops, are driven by link leather belts. These belts are "old" in that country, but they are claimed to be superior to any other.

The English lathe, with its open head and tail-stocks, and exposed gears—having no apron—cast gears of coarse pitch, etc., is an awkward looking machine, and certainly lacks the adaptability of the American lathe; but it has one excellent feature, a good long compound rest, capable of boring clear through a hole without re-setting the tool.

The subject of Jim Crow planers suggests the idea of a Jim Crow shaper. Many of the large, long bodied traveling head shapers are too expensive for the limited range of work that can be done on them. The ordinary machine is confined to the length of its stroke, and the length of the machine planing crosswise, with only an occasional job requiring its full length. If the feed motion, say four feet long or more, were provided with a powerful screw, and power applied to it, screw planer fashion, the ordinary power motion being used for a feed motion meantime, and *vice versa*, the new power motion thrown out of gear, and the machine used in the usual way, its usefulness would be greatly increased. This would require the head of the tool slide to be turned at right angles for the new power motion, which can easily be done by a substantial knuckle joint with a single bolt to tighten it in either position.

The idea of applying power to both motions is not new, but is used in the Scotch "wall planers" in the marine shops.

When the stroke of a shaper is carried beyond 12 or 14 inches it becomes unsteady; hence, if longer work is to be done, it may be preferable to use the screw power motion; anyway the same size machine would cover a greater range of work than with the crank motion only.

The managers of the great naval exhibition at Chelsea, England, have consented to allow the model of Nelson's ship, the "Victory," to be transferred to the Columbian Exposition.

Whaleback Steamer "Wetmore."

The accompanying illustrations represent the general appearance of the whaleback steamer "Charles W. Wetmore," and two views of her engines. She was originally built for coast service, but has crossed the Atlantic successfully, and her arrival in the river Mersey created much public interest. The design of her hull is an innovation in marine architecture, probably the greatest since Ericsson's monitor was put afloat. She is 265 feet in length, 38 feet in breadth, and 24 feet depth of hold, draws 15½ feet of water, loaded, and has a dead weight capacity of 3,000 tons. She is round decked, flat bottomed, and ended up like the pointed end of a cigar. The hull is built of steel. The forward turret contains the windlass and companion-way leading to the forecastle below. The wheelhouse and cabin are set up on the three turrets aft; the forward one of this set of turrets protects the smoke-stack, the second one is over the engine, and the third one is for the companion-way. With this arrangement a ponderous bulk above the water to catch and fight the sea in a storm is avoided; in high seas the water may wash over the deck without meeting any serious obstructions, and this is one of the peculiar features of the vessel.

The engines are of a vertical direct-acting, surface-condensing type, set fore and aft, and drive a propeller. The high-pressure cylinder is 26 inches diameter; low-pressure, 50 inches diameter; and both have a stroke of 42 inches. The main valve in the high-pressure cylinder is fitted with a Meyer cut-off valve, and the low-pressure cylinder is fitted with a double-ported rolling valve adjustable by means of a slot in the reverse lever. The surface condenser, which is also arranged to work as a jet condenser, if required, is fitted with ⅝ inch (external diameter) tubes, packed with patent paper packing; they expose a cooling surface of 1,200 square feet. The circulating water, which enters the condenser at the bottom, and passes out at the top from the same end, is supplied by a double-acting pump 11½ inches diameter and 20 inches stroke, worked from the forward end of the pump shaft. The air pump, which is single-acting, has a diameter of 19 inches; it is worked from the crosshead; and from the same crosshead two feed pumps and two bilge pumps are worked; each of these pumps has a diameter of 3 inches, and all have a stroke of 20 inches.

The main shaft is 10½ inches diameter, and is supported by three main journals. The crank-pins are 9½ inches diameter and 10 inches long.

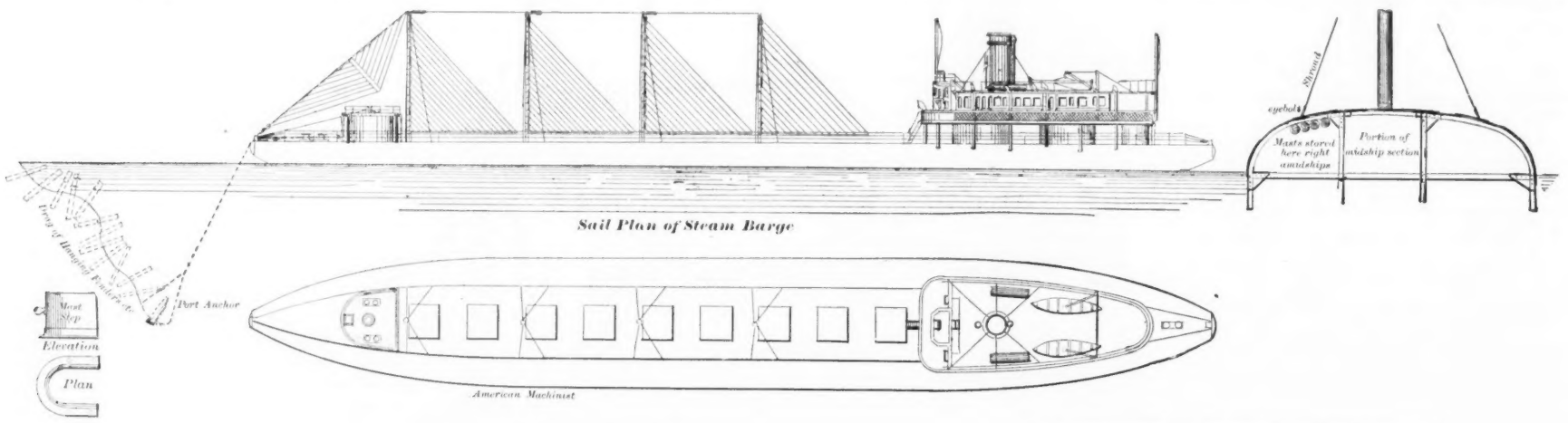
Steam is supplied by two Scotch boilers, 11 feet 6 inches diameter and 11 feet 6 inches long. Their combined heating surface is 2,930 square feet, and the combined grate area is 88 square feet. The boilers are constructed for a working pressure of 125 pounds per square inch.

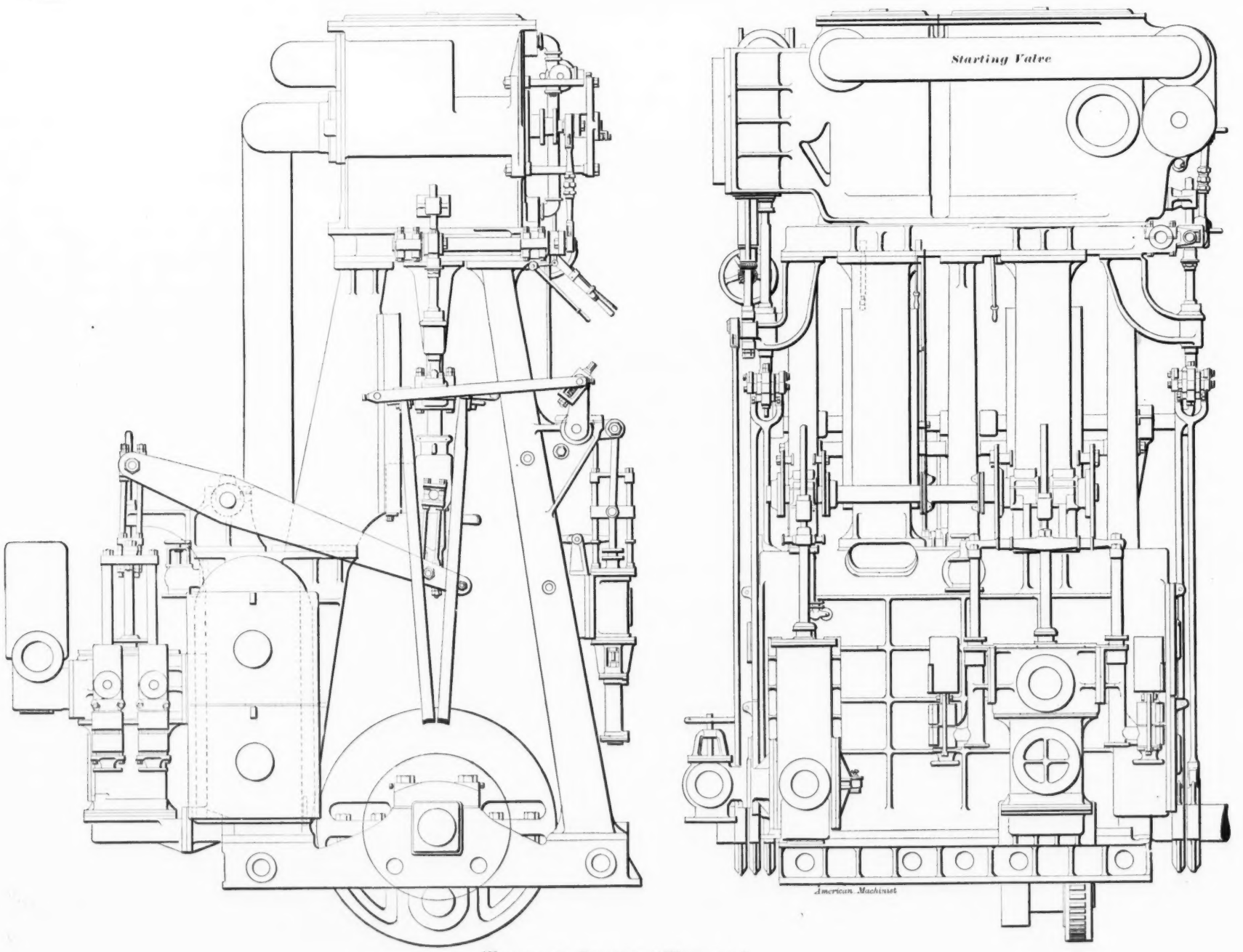
The engines indicate, on the average run, about 800 horse-power, but can easily be worked up to 1,000 horse-power.

The engines and boilers are, of course, placed in the after part of the vessel, as indicated in the illustrations; the intervening space from these to the forecastle is unencumbered, and forms the freight-carrying compartment. The hatches in the deck for loading are plainly indicated in the plan. These hatches are fitted with rubber linings, and screwed down tightly, so that they become water-tight, forming practically a sealed hull.

In case of accidents to the machinery, sails are used. In a box in the dunnage-room there are stowed away sails, tackle, mast steps, etc., the masts are stowed under the deck amidships, as indicated in the section. In the event of the machinery breaking down during a storm, and where there are no soundings, all the hanging fenders are got out of the dunnage room, and fastened to one of the heavy working lines. This line is made fast to the port anchor, as this is always ready and easily let go. This will make a good drag with the anchor hanging at a depth of about 40 feet, and working line with hanging fenders attached, as shown. This vessel has no forefoot, and the after deckhouse being larger than the forward one, she will naturally ride ahead to the wind.

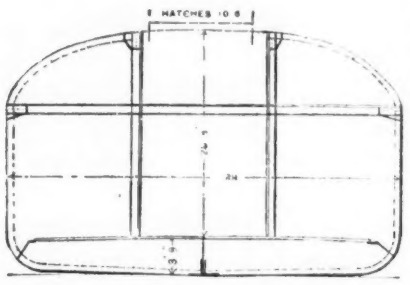
The advantages of this class of vessels are: The cost of building one is less than that of an ordinary freight steamer; its carrying capacity is greater than that of other vessels; and it can be run for less cost than an ordinary freighter.





WHALEBACK STEAMER "WETMORE."

The economic value of this vessel lies not only in her great carrying capacity, but is due also to the fact that, in addition to her own load, she is designed to tow other barges of similar construction, but which have no propelling power of their own, so



SECTION OF STEAMER "WETMORE."

that the cargo transported during one run will be very great in proportion to the engine power employed.

This type of vessel, of which tow barges, as well as steam propellers are now being built, is the result of the pressure of competition. Although the first boat of the fleet (there are now eleven afloat) excited amazement and ridicule among lake vessel builders, and was immediately denominated "the pig" by vessel men, these boats have proved to be, during their service in the face of active competition, very satisfactory to their owners, so that the laugh is now differently located.

This innovation of naval architecture comes from the head of Lake Superior. The inventor of this type of vessel is Capt. Alex. McDougall, who is now manager of the American Steel Barge Company, at West Superior, Wisconsin, where these boats are being built. It is expected that the building capacity of this shipyard will soon reach 52 vessels of this type per year. The engine for the "Wetmore" was built by Samuel F. Hodge & Co., Detroit, Mich., to whom we are indebted for the blue-print of the engine, from which the illustrations have been made.

The overhead trolley system for electric roads is rather aptly described by *The Press* as a "mighty good thing for a big city not to have." We have opposed this system from the beginning, believing fully in electric cars, but at the same time believing they should be run with less danger to human life than is offered by the overhead system.

A correspondent is desirous of knowing how he can drill holes in enameled earthenware flower-pots. He thinks the ware is too hard to be drilled with a drill moistened with turpentine.

Welding Copper.

The following comes to us from The Eureka Tempered Copper Company, and gives information such as we are glad to publish:

I see in your Questions and Answers, in your issue of August 20th., C. R. B., of Richmond, Va., writes, "Kindly inform me whether copper can be welded or not, otherwise than by brazing. If so, please give the process."

May we ask you to give him the following answer, viz.:

The Eureka Tempered Copper Company, of North East, Pa., have a process by which they make copper perfectly malleable, the same as malleable iron,* without changing its constituent parts by the use of any alloys.

This copper can be used in a common blacksmith's shop, the same as malleable iron, and can be pounded in any shape, or welded in the same manner by heating it to the proper heat, and without the use of any chemicals or brazing solders of any kind. A horse nail or a horseshoe can be made of it, or any two pieces can be welded together without any difficulty.

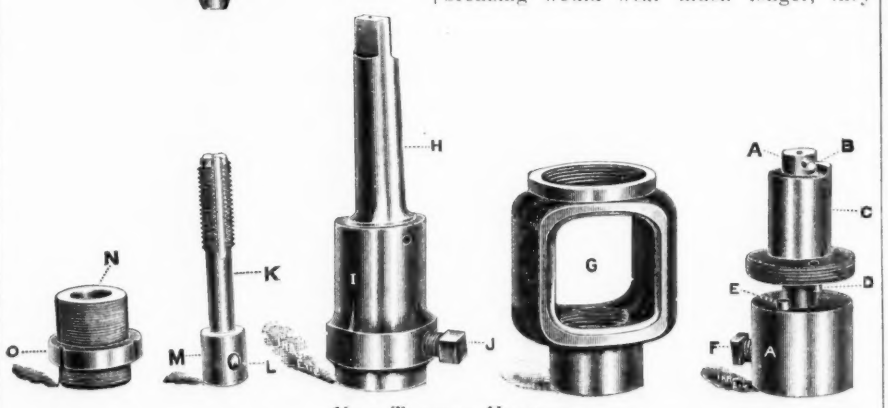
We only ask you to print this in the interest of investigators like C. R. B.

* We presume by malleable iron our correspondents mean ordinary wrought iron.

A New Tapping Head.

The illustrations on this page show the construction of a tapping head intended for use in the drill press, in which the same principles have been made use of that have been before employed with entire success on screw machines; the construction in this case being sufficiently modified to suit it to the different conditions under which it works.

Referring to engraving of the parts: *H* is a taper shank socket which goes into the drill press spindle in the ordinary manner. Into this socket fits the flanged sleeve *C*, through which passes the shank of the



NEW TAPPING HEAD.

socket *A*, and which works freely therein. In the flange of *C* there is a pin *D*, which, coming in contact with pin *E* in the socket *A*, drives it while the tapping is being done.

The outer edge of the flange is threaded to fit the upper end of the case or frame *G*, and the lower end of *G* is threaded to receive the thimble *N*, which has a left-hand thread running its entire length, to which is fitted the collar *O*. The tap passes through *N* a distance equal to the depth of the tapping to be done, as shown in the general perspective view, it being secured in the socket *A* by the set-screw in the usual manner.

Now supposing the drill press to be provided with a backing belt, and the device to be in use, the tap is brought down to the work, and there stops until pins *D* and *E* come into contact, and the tapping begins and proceeds until sleeve *N* comes into contact with the work. When this happens all parts of the head except the socket *A* with the tap are prevented from going down further, and, as the tap continues to descend, the socket *A* is drawn down until the pins *D* and *E* are disengaged. The machine is then reversed, and, the spindle being raised, the pin *B* in the upper end of the shank *A* comes into contact with the shoulder made in the sleeve *C*, and the tap is thus backed out.

When the similar device is used in the screw machine for threading screws or tapping, the frame *G* and sleeve *N* are dispensed with, for the reason that the stop on the turret slide performs their function, which is to define or fix the depth of the tapping. Otherwise the device is the same, and it is the favorite one for screw machine work, having been tried sufficiently to prove its great value. The head is made by the Hurley Manufacturing Company, Erie, Pa.

Sharp vs. Round Corners.

In the first number of *The Compass* the editor has something to say regarding drawing instruments, and amongst their characteristic features mentions angles that are "sharp and well defined." The makers of drawing and engineers' instruments have adhered to this characteristic feature long after the reason for it has disappeared, it seems to us, and we think now that it is high time that a characteristic feature of high-grade drawing and engineers' instruments should be neatly rounded corners, and entire absence of sharp and well-defined angles, except where needed for some specific reason. If you talk with an instrument maker about this he will probably tell you that square, sharp corners are an indication of good workmanship, and he sticks to this time-honored fallacy, in spite of the fact that the poorest and meanest instruments to be found have just as sharp and well-defined angles as any of them, and that machine-finished instruments—which are the cheapest kind of instruments—have the sharpest corners. In every other branch of mechanics the square corner nonsense has been long since abandoned, and it is well known that properly rounded corners, neatly finished, are an indication of good workmanship, while no one will think of denying that for all practical purposes they are much better and more pleasant to handle.

In the case of field instruments, especially, if made with rounded corners they would be much easier kept clean, the lacquer and bronzing would wear much longer, they would be pleasanter to handle, and would be much more neat in appearance. Instrument makers might learn a lesson from American tool builders on this point, and when they have learned it, as they eventually will, we shall see much better looking instruments. Let some well-known instrument maker adopt the plan of making instruments both with square sharp corners and angles, and with well-rounded corners and angles, guaranteeing the finish and workmanship to be the same in either. We predict that before long he will see the wisdom of abandoning the sharp corner idea.

A New Surface Gauge.

On this page we give an illustration of a new surface gauge, in which the distinctive features are an extension above the base in which the stem is clamped by an eye-bolt, above this being a clamp collar having an adjusting screw by which the stem and needle may be adjusted as finely as required. The head which holds the scriber may be put between the extension and the base when it is desired to lay out work near the surface upon which the gauge rests, and as the stem is a plain straight rod, not permanently fastened to the base in any way, it may be replaced by longer rods for special purposes, or the stem with the head and needle may be used in setting work in the lathe or drill press, where they can be used as a tram.

To one of the straight sides of the base there is attached a straight-edge, which can be turned so that it projects below the edge of the base, and thus the gauge may be used in lining up work by the edge of a planer platen or milling machine table, or by the shears of a lathe. When not in use this straight-edge is readily turned up out of the way, so that the use of the gauge in

NEW SURFACE GAUGE.

the ordinary way is not interfered with. It will readily be seen that the gauge possesses several very good points which will be appreciated by machinists. It is made by E. G. Smith, Columbia, Pa.

William Wilson.

William Wilson, who until within a year or so was superintendent of machinery on the Chicago & Alton Railroad, died in Chicago in August. The cause of his death was nervous prostration. When he began work for the Chicago & Alton, at Bloomington, Ill., he put all his energies at work to build and equip the best railroad shops in the country, and he succeeded in doing so. His skill as a mechanic and engineer were visible in every department of the works. In our issue of June 26, 1886, we described some of the features of these shops from personal observation. About that time Mr. Wilson was engaged in bringing out a new valve motion to supersede the link. This new valve motion, although ingenious in construction, did not prove itself to be as successful as he hoped, or at least it was not appreciated as he believed it would be, and no doubt this, added to his other work, brought on the disease that eventually killed him.

Mr. Wilson, we believe, was something less than sixty years of age, but if his life work was followed up it would be found that it amounted to more than that of most railroad mechanical men who have kept in the harness for a good many more years than he did. His life work has been an important one, and he has left an impression that is valuable to those who may follow him.

One of the most remarkable instances of the growth of an industry has been in the instance of the manufacture of steel. It is no more than a few years since men expected to pay a price enormous by comparison for all the steel they used, and it wasn't much. It was all made by the old laborious process. But when a start was made in the cheaper processes men by the score turned their attention to cheapening the product, until now "all shafts made of steel" has little significance except that the steel may be better than iron. And steel boilers were a rarity, but now steel is by far the most common metal used in boiler construction. This cheapening of steel shows what a good many men working in a given direction can accomplish in the way of cheapening the cost of any common product. No one doubts but the world is better off for such efforts. Cheap steel makes the world a better place to live in.

The Pratt Institute.

We have received a circular from this trade school, which is located in Brooklyn, N. Y. This circular gives information of importance to young men who would like to go through its courses of instruction. The tuition fees are very low. Any information can be had by addressing The Pratt Institute, Brooklyn, N. Y.

Electrical Transmission of Power Abroad.

In proportion to its area, there is probably no other country in the world where water power has been utilized to such an extent as in Switzerland, and this fact has been remarkable in so far as the electrical transmission of power is concerned. It has been found that the employment of distant waterfalls for this purpose has proved economical, more so, indeed, than if steam power had been used in the localities to which the electrical energy is transmitted. At the receiving stations the current has hitherto been distributed for lighting, and, to a certain extent, for motive power purposes, the latter object being mainly confined to the driving of machines and tools. If we remember rightly, in no case has the electromotive force exceeded 3,000 volts, but at the Frankfort Electrical Exhibition next month, electrical energy is expected to be received from Lauffen at 20,000 volts pressure, and after conversion the current will be used for producing light, and for driving some of the machinery exhibits. This scheme is, however, only an experiment, but another—one which is important from a traction point of view, and which appears to be a new departure—is proposed by Herr Zipernowsky to be put into practical operation in Vienna, in view of the working of a tramway in that city, and upon which the cars are to travel at twenty-five miles an hour. Herr Zipernowsky suggests an electrical system of distribution in which both continuous and alternating currents are to be used. In this case, an alternating generator, giving current at 10,000 volts, would be placed a considerable distance from the town, and the energy produced would be transmitted to a motor erected in a secondary station. This motor, which would have to be started by a separate machine, and would have to be kept in operation by the latter until it became synchronized, or in step with the generating alternator, would actuate a continuous current dynamo. The latter would then supply current for the working of the motors driving the tramcars. This combined system would allow of the utilization of waterpower too distant to permit of the exclusive use of a continuous current method. Considering the conclusions of the Frankfort Technical Commission a year and a half ago, regarding the synchronizing of alternators with alternating current motors, Herr Zipernowsky's system seems feasible, the only difficulty appearing to be the insuring of efficient insulation of the conductors, which would doubtless be carried overhead; but the results of the Frankfort-Lauffen scheme will throw light on the practicability or otherwise of using very high tension current for long distance transmission. An electric light and power installation has been inaugurated at Oyonnax, in the Ain Department of France. The motive power is obtained from the river Oigrim, a tributary of the river Ain, and the height of the fall is 170 feet, the available power being 1,750 horse-power. The plant comprises two turbines with horizontal shafts, which are coupled direct to two Thury dynamos of 150 horse-power each. The speed is 350 revolutions, and the output of each machine is 105,000 watts, the electromotive force being 2,000 volts. The dynamos are arranged in series. The distance separating the generating station and the receiving depot is five miles, and the current from the former to the latter is transmitted by overhead conductors on the three-wire system, the loss in transmission being about 10 per cent. At the central station in Oyonnax the current is received at 1,800 volts by two motors placed in series, and each of 120 horse-power. These motors actuate direct two low-tension dynamos having an output of 600 amperes at 125 volts, and the current is then distributed on the three-wire system in the town, for both lighting and power purposes. The total efficiency of the plant is 76.2 per cent.—*The Engineer* (London).

LETTERS FROM PRACTICAL MEN.

The Crosshead Question.

Editor American Machinist:

The question asked by A. P., Arizona, No. 389, in issue of Aug. 27, in regard to crosshead of locomotive, is an interesting one to me, as I have had many an argument on the subject with my fellow workmen. The problem seems so plain to me that I am prompted to attempt to give my views on the question to the readers of the AMERICAN MACHINIST, hoping I may be able to make some of them see it as I do, for I believe I am right, a perfectly natural way of thinking until convinced to the contrary. What I have to say will not be in learned language, for the simple reason that it would be impossible for me to do so, as I am not an educated man, and this is the first attempt at anything of the kind, and it is possible I may not be able to make myself understood. The question is, Does the crosshead of a locomotive ever come back? I say no, unless the wheel slips on the track. In that case it does come back, and consequently the train does not move. In order to move the train there must be a resisting force somewhere for the steam to operate against to push the train ahead. I contend that the piston head forms that force on the instant it has made its forward stroke and brought the crank-pin in a position to pass on the under half of the wheel. At that point it becomes a fixture because of friction of wheel on track, which prevents any backward movement. Now the steam port at the forward end of cylinder is opened, and the steam passing between the cylinder head and piston head forces the cylinder off the piston, and accordingly moves the train forward. At the end of the stroke the crank-pin is brought in position to pass on upper side of wheel, and the steam taking effect at the other end of cylinder forces the piston into the cylinder and rolls the wheel over, carrying the piston to the forward end of cylinder again. At this point the same thing happens as before; the piston stops and the cylinder is pushed forward instead of the piston going backward. If this were not so, it would not be a locomotive, but a stationary, instead. It will readily be seen that, in order for the piston to come back, it has got to overcome the friction of drive wheels on the track, in which case I am afraid you would accomplish your journey sooner by walking. W. M.

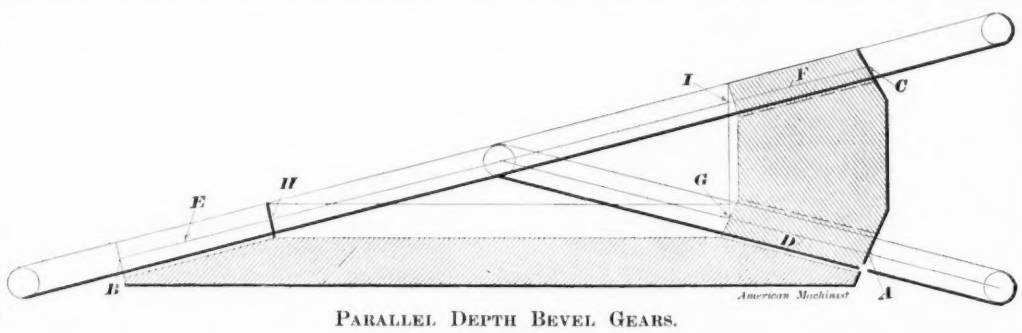
Parallel Depth Bevel Gears.

Editor American Machinist:

Gears made in this manner are not compared to planed bevel teeth, but they are much better than the ordinary milled bevel gears, and cost no more, while their cost is but a small part of what the expense is to plane wheels.

In the sketch there are shown two bevel wheels in central section. The blank construction is indicated and the relative sizes are as 4 to 1. It is intended to show in this sketch two gears 8 P., 48 T. and 12 T., and while the sizes at the greatest pitch diameters are to 8 P. calculations, it is intended to cut the gears with 10 P. cutters of suitable shapes and thicknesses, and to cut them 10 P. depth. The pitch cone being cut in straight lines toward its apex, the teeth are of correct form at their middle height and length, on their most critical points. Also when the shapes are right at the pitch and at the middle length, the shapes on the addenda, on the small and large ends, will be approximately correct. But, if the shapes are right only at the inoperative extreme roots of the teeth, and at the larger ends of the teeth, then all other parts of the teeth will be wrong, and increase in error as the distance is away. The 10 P. diameters are indicated by *D E* and *D F*, which are intermediate between *A B*, *A C* and *G H*, *G I*, and consequently the teeth are correct at middle length. The cut being parallel to the pitch cone also makes the teeth correct at the pitch the whole length of the teeth.

A. D. PENTZ.



PARALLEL DEPTH BEVEL GEARS.

Babbitting Bearings.

Editor American Machinist:

There are many things to be taken into consideration and intelligently manipulated in order to produce a first-class babbitt bearing.

First, it is very necessary that the box to be babbitted be clean and dry, and in order to be sure of this it is necessary to heat or burn the box, thereby removing all grease and dampness.

In large bearings it is nearly always convenient to make an arrangement with sheet-iron, etc., to hold a sufficient quantity of hot coals of fire from hard wood, whereby the box may be made very hot, and while this is being done other arrangements may be carried on, such as heating the metal, which should be done on a slow fire, the shaft having been previously arranged in its proper position upon supports (outside of the box, while the bottom box is being made). This arrangement is considered best where it is convenient to fire a box.

Well-kneaded putty is far better than clay mortar to use around the shaft at the ends of the box, and will stand considerable heat without interfering with its tenacity.

It is important that the metal be poured while the box and shaft are at their highest heat, thus obviating the necessity of overheating the metal, which is a very important point; also rendering it possible to pour the metal slowly, thereby allowing the air to escape easily and freely, and not interfere with the perfect settling of the metal.

Small bearings can be heated by holding an old scoop full of hot coals under them for a few minutes, except where a box is attached to a wooden bridge tree; in this case the box must be removed and burned out in order to thoroughly clean it; then, if replaced while yet not quite hot enough to burn the wood, it will stay warm for quite a while, and impart heat to the shaft, which will materially help in producing a good bearing.

I find in my experience that it adds materially to the life and good conduct of a bearing to remove the shaft after the metal has sufficiently cooled, and cut a groove nearly full length of the metal in the bottom of the box, to be proportioned in width to that of the box. Say for 1½-inch shaft make the groove $\frac{3}{16}$ inch wide and ¼ deep, and for an 8-inch shaft make the groove ½ inch wide and ⅜ deep. This will serve both as a pocket for oil and a trap for dirt that will work into a bearing, and should be cleaned out occasionally.

To get the benefit of the good qualities of the metal, don't heat much above the melting point. To heat babbitt metal red hot is to ruin it, and a man that will persist in so doing will generally be found doctoring hot bearings.

The ladle is also worthy of consideration, and should be made, with an eye to convenience, out of iron as light as possible, and the bowl tolerably deep; nine ladles out of ten in common use are too shallow and flaring. It should be carefully balanced by making the out end of the handle very heavy, that is, in proportion to the size of the ladle, and a large ring turned on the end of the handle. S. A. SMITH.

The Slide Rule.

Editor American Machinist:

Anent Mr. Sellers' recent enthusiastic praise of the slide rule, a little experience of my own may not be uninteresting. Some years ago, when quite a youth, I was considerably engaged amongst cotton machinery, and found the slide rule to be an exceedingly convenient aid to effecting changes in the wheels which were necessary to change, in order to alter the counts of yarn to be spun.

These changes involved the use of the rule both direct and reverse. For example: when spinning finer yarn the counts are higher, and a larger driven wheel on the front roller is needed for coarse counts than for fine, and hence the rule of three for this change was the inverse rule, and the slide is used reversed end for end.

Other wheels which determined the number of turns or twists per inch were changed in the ratio of the $\sqrt{\text{counts}}$.

The foreman whose duty it was to change these wheels never could be taught how to do it in the ordinary way with a piece of chalk, but I taught him easily to use the slide rule, and he became quite proficient in it, and ever after followed the method much to his own gratification, for up to that time his dullness with figures had been a source of continual mortification to him, and he felt naturally annoyed at having to send down to the office when a change was to be made.

The slide rule in special forms is much used in the textile districts for all similar purposes. As regards the engineer's slide rule, I fancy that the general practice of this instrument is much after my own experience of it; that it is very handy to measure the depth of a drilled hole, for I have rarely seen it applied to any other use, though I am informed it is as convenient as I knew it to be in my younger days for textile purposes. W. H. BOOTH.

Paying for Labor.

Editor American Machinist:

In reference to premium plan of paying for labor, also profit sharing and job work mentioned and discussed for some time, there seems to be lacking of the mention of the principal thing which governs cost, namely, quantity. If I am obliged to rig up any machine, and some machines require a great deal more than others, I could not do 50 pieces at the same rate as 5,000, on account of the time required to get started; and as changes are constantly being made, both in machinery and goods, new prices have to be made also.

Mr. Richards' article in your late issue, which I have just read, seems to me to come nearest to the solution of the difficult problem. We must continually make careful estimates, and if our competitor goes below our price we cannot give up without a struggle to meet his price, and the workman, if he can, will also reduce his job price before he loses the order or is cut short of work, as will sometimes be the consequence if he fails to do all he can towards the same end. If he unfortunately gets less than he thinks he ought to receive, he is soon looking up another job, and generally finds it, so that the writer does not see how

there can be a definite fixed price for the manufacture of goods. In my opinion, true estimates, quantity specified, and faithfulness to workmen as well as to the corporation, must gauge the prices paid, as the cost is constantly changed by the consumer, by the manufacturer, and by the workmen, if we keep peace and prosperity within our borders. G. E. W.

Before and After Thinking.

Editor American Machinist:

One of the surest ways of getting poor work is to get the job done, and then think out a good way to do it. It is true that after doing a piece of work once we can in most cases greatly improve on the first method, but we should not go at it blindly, trusting to luck to bring us out all right.

There are men who, if they should show the same ingenuity in getting their work done right that they appear to exhibit in getting it wrong, would have their pay raised right off.

I have had "that tired feeling," that no patent medicine could cure, come over me when I found a boy spoiling work in a jig that was my particular pride. The jig was my pride, not the boy. He had "fixed" the jig so the work would go in either way.

The man who thinks afterwards is generally a capable man; he is capable of finding more ways to spoil work than one would think possible. He can always find a way to hold work in a milling machine vise, so that, when nearly through, the mill or saw will jam and break. He will lace a belt open, after cutting off some of it, and then find out that it should be crossed. He can use the piece he cut off to fix it with if he has not thrown it away, and to make sure he has the right side next the pulley, he can give it one more twist and run both sides in.

He is what he calls an all-round man; he can do one thing about as well as another.

He has one screw-driver which he uses on a number six or a $\frac{3}{8}$ screw with equal facility and a nice chisel point. "It will fit anything" is his reason for the shape, and sometimes it slips out of the slot and fits into the other hand.

He has been known to cut off stock so far from the chuck that he had to set his cutting-off tool round at quite an angle in order to cut off square. He did that to save time, as he did not have to move the work in the chuck so often, and he was discharged to save cutting off tools. One would hardly believe the number of tools we have saved by letting him go.

He came recommended as a mechanic who would make his mark, and I believe it now when I look at some of the tools he worked on. He did not seem to be particular what he made it with, either.

This style of mechanic will measure and mark a piece of work very carefully, and then cut it off just the width of the cutting-off tool too short.

He can bore a nice hole, smooth and true to size, at one end, if he has a reamer to finish it with, but ask him to make it $\frac{1}{100}$ larger, and he is lost without something to fit it to.

He is great on making fits. Notice how he goes to work to make a nice $\frac{1}{4}''$ reamed hole and a stud to fit; how carefully he calipers the drill after looking at what there is left of the figures on the shank. He "guesses that is about right, always believes in leaving enough for the reamer anyhow." Now he gets the drill in the chuck it does not run quite true, but it is small enough; guess it is all right, so down she comes and the hole is drilled; he don't start the reamer into the work while on the machine, because he can ream it straight by hand. Now he makes his stud, turns it just full half inch, so as to make a good hard drive. Wishes he had reamed holes to fit to all the time, it is so much easier getting your sizes right. Now he will ream that hole and drive her home. But she don't ream, not by considerable; the large end of stud is loose in the hole. Why? "Because some confounded idiot has ground that drill away off the center. Just his blamed luck, after being so careful too." But he was not careful enough.

There is a temptation in a full oil-can that is too much for this man. Just see that stream of oil clear across the drill press table, and it may or may not touch the drill, or he will pour a great dose onto the work where one-tenth of it will not be used, when, if put on the drill near the top he would waste very little, and would have a more continuous supply in the hole.

A drop on the hand will show the kind of oil in the can as well, if not better than a stream half way across the floor.

He considers he has been more than careful if he wipes up the mess he makes around each oil-hole when oiling a machine, when he may have used or wasted oil enough to feed that machine for weeks if put in the right place, and it is of some importance where the oil goes. I have known bearings that for years had a semi-weekly bath, and been well rubbed down afterwards, to rough up, and be mean, simply because the oil-holes were plugged with dirt.

The man who thinks first is far different; he is not all the time in trouble; he seems to take hold of his work right end first, and when given something to do the foreman is reasonably sure it will come out all right. He can do a job while the other man is finding fault with the tools that he has helped put in their present condition, and without the whole shop knowing what he is doing. He is not afraid of the grindstone.

He sometimes changes the speed of his machine, his feed belt is not on the middle step all the time.

He is awake, his machine is doing lots of work without that spasmodic splutter so noticeable in the machine of the blind rusher. He has the greatest "luck" too, he makes so few mistakes. It must be luck, for others in the same shop on the same work, who sweat more than he does, do not make so good a showing for a day's work, although they may have done some of their work over twice and got their faces and hands dirtier.

He is not full of excuses that don't excuse, nor does he think that the fact of that being the first one he did is sufficient reason for spoiling it, when, although new, it was all straight work. When given a sample to work from he does not cut that thread 20 when the sample is 16.

By doing his own thinking instead of having it done for him, and by doing it soon, he does not have to explain to the Old Man so often how that some one else is to blame for his work not coming right. How few mistakes we would make were we all careful enough.

Some one has said "Accidents are the result of unpremeditated carelessness."

I will not attempt to mention the numerous qualifications a boy should have to make a good machinist, but will say that laziness, flash literature, tobacco and profanity are not all that are required. And the fact that the boy has made a dismal failure in perhaps a dozen different occupations within a year is not sufficient evidence to my mind that he will be a bright and shining light in a machine shop, as some parents seem to think.

They think, some of them, that a machine shop is the last place to send a boy into, so it is the last place they send him into; after he has tried about everything else and failed to get ahead he is put where they think he don't require one. They are partly right, too, for a machinist does not require the style of head that style of parent puts on that style of son, although the boy may have done all he could to fill the cavity with the inspiration or whatever it is he absorbs from the end of a cane. W. HADDOW.

The Pressure and Coefficient of Friction on Sheet-mill Necks.

Editor American Machinist:

I had expected when I wrote the article (Some Rolling-mill Notes), appearing in your issue of August 6, that some one would object to the assumed pressure of 5,000 pounds per square inch. I did not see then, nor do I now, how it can be less. In your issue of August 27 Bell Crank treats this pressure with levity, and my assumed coefficient of friction very logically. Replying, I will say: From the fact that the housings break, it is evident that they are never too strong. From the fact that they do not break while the mill is standing, it is evident that the pressure required to break the housing is sustained while the roll is in motion. From the fact that cast-iron does not break under a tensile stress of less than 10,000 pounds it is evident that $\frac{408 \times 10{,}000}{144}$ = the pressure per square inch on the roll neck. This is not an every-day pressure, of course, but if such never occur, what breaks the housing? I do not know of any way to determine with any degree of accuracy the pressure on the rolls. I have thought of interposing an hydraulic cylinder and piston between the top carriage and screw, and attach a pressure gauge to the cylinder. The area of the piston multiplied by the pressure would tell the story. Will Bell Crank please suggest the dimensions? There is a space for anything 12″ diameter and 12″ high, or it may be 16″ × 12″ × 12″ square.

I do not know of any other instance where such extreme pressures exist. I have heard of locomotives with a weight of 41,500 pounds on a pair of drivers. Call the surface contacts of both wheels on the rails 3″, hence $\frac{41{,}500}{3}$ = 13,833 pounds per square inch on the rail. These wheels will slip for at least one or two revolutions on a dry rail without doing any material injury to rail or wheel; this being the case, why can't a roll make two or three revolutions under a like pressure, especially when the lubrication is as perfect as possible?

Now for the coefficient. I took it for granted that the reader would know that a sheet-mill is not a continuous mill, and as Bell Crank has described its operation, all I can do is substantiate my assumed coefficient with such authority as I can find.

One author, in experimenting upon the friction of lubricated journals, makes these statements: "At velocities of from 2 to 18 feet per second the coefficient was much less under high pressures than low ones." The coefficient increased rapidly as the temperature rose from 100° to 120° and 150° Fahrenheit.

Another author, in experimenting in the same line, found that "at starting, the coefficient increased with the increase of pressure, as it did also when in motion."

How are we to harmonize the experiments made by these gentlemen? Prof. Thurston is credited with this formula: Coefficient when the shaft is revolving = (.02 to .03) $\times \frac{\sqrt{5}\text{ rev. in ft. per min.}}{\sqrt{2}\text{ press. in lb. per sq. in.}}$

This is approximate for journals in good condition, well lubricated, and at ordinary temperatures, speeds and pressures. Applying this formula to our sheet roll we have (.02 to .03) $\times \frac{\sqrt{5}\ 160}{\sqrt{3}\ 5{,}000} = \frac{2.76}{70.71} \times .03 =$ .0117.

One experimenter gives a very interesting table of experiments made with steel journal in bronze bearings with standard sperm oil used for lubricant, with varying pressures, speeds and temperatures. The highest coefficient is .125 for a temperature of 130°, a pressure of 4 pounds per square inch at a speed of 30 feet per minute.

The lowest coefficient is .0019 for a speed of 100 feet per minute, and 100 pounds per square inch. The coefficient is the same for 90° and 130°. Here is room for speculation. If the ratio should be maintained from 100 to 5,000 pounds pressure, the same as it is from 4 to 100 pounds, a 10″ engine would be all that is required for a 20″ mill.

C. O. SINE.

The Weight of Fly Wheels.

Editor American Machinist:

Now that Prof. Torrey has produced a formula for the weight of fly wheels based on the old theory of periodical fluctuations, it would not be amiss to consider the rather pertinent question: Will this theory apply to modern engines? Is it the sole or main office of the fly wheel to keep within bounds the periodical variations in speed caused by the varying rotative effect on the crank? That such variations do exist is obvious; but how do they affect smooth running? What is the effect of such fluctuations practically?

Bolton & Watt built large engines making 30–40 revolutions per minute driving flour mills through gearing. The inertia of the millstones was considerable, and a slight momentary variation in speed would cause rattling of the gears, which probably were not of best design and workmanship, and it is evident that the "equalizer" here would be of excellent service. But let us consider a modern steam engine making 200 revolutions per minute. How many times in a minute will it change its speed on account of the varying rotative effect on the fly wheel? The speed will reach its maximum and minimum once every half revolution, or 400 times in a minute, or more than six times in a second! Was an engineer ever troubled with such variation in speed? The reader can obtain a fair idea of what this means by striking the table six times in a second. Engineers running electric light plants might tell us something interesting on that point, for electric lights are fine indicators of speed. Did the intensity of the light ever change 400 times in a minute with an engine making 200 revolutions, or 200 times with an engine making 100 revolutions, or 600 times with an engine making 300 revolutions? If not, then any unsteadiness of the light which might occur would not be caused by such fluctuations, then the varying rotative effect on the crank had nothing to do with it.

Engines with comparatively light wheels will be found more liable to variations in speed than those with heavy wheels, but such variations are caused by oscillations of the governor weights, which might be prevented by using a heavier fly wheel, and are entirely independent of fluctuation in speed caused by the varying rotative effect, and are of much longer period or duration. It would be interesting and useful to get some more light on this subject derived from practical observation, but great care must be taken in making distinction between fluctuations in speed caused by the action of the governor and those caused directly by the fly wheel. If a governor could be made to work properly in connection with an extremely light or small fly wheel we might have some hope of getting the question answered by direct observation, for then the fluctuation would be so great as to have some effect on electric light at least. But whatever the result would be with an engine directly connected with the dynamo, it is not likely that it would be noticeable through a number of belts and shafts. Has anybody seen the electric light change 400 times a minute? J. BEGTRUP.

Some time ago there was described in the *English Mechanic and World of Science* a taper attachment which appeared to have some features about it that passed understanding, and for which experienced lathemen could imagine no possible use. The writer from whom we quote below, and who signs himself F. A. M., refers to this in his letter, which we reprint from the *E. M. and W. of S.*, and incidentally to some other things of interest:

. . . . "With regard to Lord's taper turning attachment, will some one kindly explain what is the use of the *two* slides? The use of the upper one shown obliquely is evident; but what is the under one for? 'Made in England' tells us it was used in England twenty-five years ago, and I should like to ask, if that is so, why it is we cannot have these things described for us at first hand in the *E. M.*, without having to get English inventions filtered through the AMERICAN MACHINIST? This is a thing that I have puzzled over many a time.

"Do our lathemen know what is a center indicator, used for testing the truth of the running center, or for setting a piece of work true on the face-plate to a center punch dot, when a hole is to be bored in exactly the right position? Several forms are described in the AMERICAN MACHINIST, but I have never seen a word about them in an English paper. Was this invented in England too?" F. A. M.

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"The Naval Reserve."

The Boston Herald, in the courteous manner that characterizes all its utterances when difference of opinion exists, takes exception to our recent remarks on "The Naval Reserve."

What it seems mainly to object to is our plain statement of fact, as we believe, that this reserve would be better if made up more largely of men who expected, in an emergency, to stand right by the hard work of manning the guns, rather than bossing their management.

Our contemporary intimates that this reserve could be depended upon to furnish officers for the navy in time of war. There is just about as much chance of its being called upon to do this as there would be, as Horace Greeley once said, of a man's being struck twice by lightning in one shower.

If the naval reserve is to be of any consequence it will furnish men to man the guns in times of an emergency; men who, stripped to the waist, will *fight*.

Anent some remarks we made about the non-appearance of "crack" regiments during the late dissatisfaction, our contemporary remarks: "We think that the bulk of their ante-bellum members were hurriedly gobbled up on all sides to officer what the AMERICAN MACHINIST calls the ordinary sort of men, the regiments which counted."

Some little experience leads us to doubt this opinion. Northern regiments in that unfortunate difference of opinion were not officered by men from the ranks of "crack" regiments, not so far as our observation goes. They were officered by pretty level-headed men, no matter from what ranks of life they came. Very few members of the "crack" regiments of the country ever saw more than a few days' service.

Our contemporary has confidence in the naval reserve; so have we—some.

The cost of running an engine lathe, or almost any ordinary machine tool, in proportion to the work done, is a rather insignificant item. The power required to run a machine shop is largely made up of moving the shafting and counter shafting necessary to reach the lathe or other tool. Hence those who have advocated for the past ten years the use of heavier spindles for machine tools have had reason on their side. Scarcely a manufacturer of machine tools brings out a new one of the type that requires a central spindle, that does not increase its size. Under general conditions there must be a limit somewhere, but that limit does not seem to have been reached yet. The cost of turning the large spindle bears no comparison to the increased work possible. The introduction of the "anvil" principle in the construction first formulated by Mr. Charles T. Porter, and put in verse by Oberlin Smith, is growing in favor every day. The fact that cast-iron is cheap has resulted in its more extensive use in the construction of machine tools, and massiveness has become the rule. Every year the quality of such tools is being improved, both by finer construction and a freer use of material, and still there is room for further improvement.

One of the best tests of a steam plant consists in measuring the power used and the coal consumed each day, taking into account coal used in banking fires, etc. What a proprietor wants to know is how much coal it costs him per day for his motive power, and in this way he will get it. All he has to do is to provide his engineer with an indicator, and a means of ascertaining the amount of coal burned. We do not mean to say that this should take the place of exact tests made with all requisite appliances. Such tests are important as showing the possibilities of a plant. They show where saving can be made, and help the engineer in improving results. But the regular determination of the power used and the coal consumed should not be neglected. Fortunately, the plan of providing engineers with means for knowing what they are doing is fast coming to be the rule, and it never fails of improving results.

The cities of Newark and Jersey City, N. J., are to-day using water that in its quality of unfitness for drinking rivals almost anything of the kind in the world. Manufacturing interests, as we have frequently pointed out, are injured by the use of such water, and now, according to the opinions of physicians, this water is responsible for the great spread of typhoid fever in these cities. The problem of getting reasonably pure water is one of the most important that can engage the attention of the authorities of any city. It is a problem that is interesting New York just at this time. An examination of the Croton water shows it to be rather replete with impurities, and those who are responsible for these impurities are very much inclined to ask what the city authorities are going to do about it. They will go right on polluting the water unless they are bought off.

The new twelve-inch gun built at the Watervliet arsenal has now had four trials at Sandy Hook, neither of which appears to have been satisfactory. The expected initial velocity of between 1,900 and 2,000 feet has not been reached, and the result of some thing less than a full charge of 440 pounds of powder disabled some of the mechanism, that will require some considerable time to repair. So far it may be said that the gun is behind expectations.

And this is the case, we believe, with the twelve-inch steel mortar recently tried. But in these trials it should be understood that the quality of the powder used is on trial as much as the gun is, so that there is strong ground for the belief that both gun and mortar may yet come up to the requirements.

Mr. F. W. Vanderbilt has had a high-priced yacht built across the water, and rather naturally objects to paying the duty of forty-five per cent. demanded by this government. This forty-five per cent. amounts to an increase in price of somewhere between thirty and forty thousand dollars, all in the cost of a vessel which, probably, could have been built as cheaply and as well here as anywhere. It is understood that he will pay the tax under protest, and then contest the case in the courts. There is considerable opinion to the effect that he will win the case, but upon what grounds we are unable to see. It will be, we should think, a rather interesting case.

It has been, as previously stated by us, ruled that when there are not men in this country competent of working in any industry, then such men could be imported; it has been claimed that such men for working in the industry of making tin plate were not here. But the Amalgamated Association offer to furnish men for this purpose in the proportion of about two hundred for every one required, which rather knocks the bottom out of the demand that such men be admitted in spite of the contract labor law.

Prof. John Rae, F. R. S., takes stock in the recent alleged production of rain in this country by explosions in the cloud regions, so far as to express the opinion that heavy rains resulted in Britain from the recent practice firing, and during the naval salutes between English and French fleets. Professor Rae thinks that a large amount of the damage to crops by heavy rains, in the vicinity of the firing, was due to the great discharge of gunpowder.

A good many years ago, when the old Novelty works were in operation in New York, persistent efforts were made to work up a system of cutting metal by the use of soft iron disks. We never quite knew the reason of the failure, but there appears to have been a failure.

We must again ask correspondents to give their full name and address if they expect attention to be paid to their communications. A neglect to comply with this reasonable request sometimes sends good articles to the waste basket.

Literary Notes.

A PRACTICAL TREATISE ON THE INCANDESCENT LAMP. By J. E. Randall, Electrician of the Incandescent Lamp Department, Thomson-Houston Company.

As its name indicates, this treatise is intended for those who wish to know something of the incandescent lamp, its history, development, manufacture and use, but who lack either the time or inclination to make an extended examination of the subject. It is written by one who is familiar with the subject, of course, and every part of it is readily understandable, even by those who know nothing of electricity. It is illustrated by perspective cuts of complete lamps and details, as well as some of the appliances used in the manufacture of lamps. The book is pocket size, bound in flexible cloth, and is sold at 50 cents. D. Van Nostrand Company, New York.

A TREATISE UPON WIRE: ITS MANUFACTURE AND USES. By J. Bucknall Smith, C. E., Author of "Cable Traction as Applied to the Working of Rail and Tramways," "Rope Haulage in Mines," "The Diamond Mining Industry of South Africa," etc.

This is a very handsome work, and we think will prove equally useful to those who for any reason wish to know anything about wire—its history, manufacture in all countries, properties, uses and applications, measurement or gauging, etc.

The first or introductory chapter is devoted to a very interesting historical treatment of the subject of wire, in which the earliest known use of wire, and the methods of manufacture first employed, are traced out in a manner which shows that much patient and intelligent labor has been bestowed upon it. Then follow chapters on the present methods of manufacture and applications of all kinds of wire, in which the subjects are treated thoroughly, and abundant use made of engravings, diagrams, tables, and folding plates. Chapter 3 is devoted to wire gauges, in which their haphazard development during former years, and the consequent confusion, are treated, with a statement of the present condition of things in this respect. Up to 1842 only twenty-six sizes of wire were regularly made. After that the number of commercial sizes rapidly increased, and in 1843 Stubs commenced to gauge his wire by "mils"—a system which was followed by Whitworth in 1857. From 1866 to 1881 the greatest confusion prevailed in regard to sizes, and methods of designating them; each manufacturer who, seeing the shortcomings of the systems then in use, essayed to overcome them, only succeeding in adding to the confusion. In Hughes' treatise, published in 1879, the author displays no less than fifty-five different gauges, forty-five of which were for gauging wire made in Great Britain. The accuracy of none of these could be depended upon, and numerous improvements were suggested from time to time, a number of the different gauges being finally amalgamated, without much regard to system, in what became known as the "Birmingham gauge."

In 1877 a special committee of the American Institute of Mining Engineers recommended that all gauging by numbers be done away with, and sizes designated in decimal parts of an inch instead, and some years later the manufacturers of Great Britain agreed upon a gauge now known as the "Imperial Standard wire gauge," which, by legislative action, is the sole legal and standard gauge of Great Britain. Nevertheless, the Birmingham and other obsolete wire gauges are used there, and are frequently referred to in the catalogues of manufacturers, frequently producing misunderstanding and legal contests. In the United States, the author says that most of the manufacturers use gauges which they designate by their own name, but that in the main these agree with Roebling's and the Washburn-Moen gauges, which are given by numbers and sizes in decimal parts of an inch, along with the Brown & Sharpe, and "Imperial Standard" before referred to. The conclusion which will be arrived at after reading this chapter is that, notwithstanding all that has been done in the way of the adoption and legalization of "stand-

ard" wire gauges in this and other countries, the only safe, logical and reasonable plan to pursue in ordering wire is to designate the size wanted in thousandths of an inch, and some number of some gauge will probably be found to suit it, if any one wishes to use a gauge on the wire. Other chapters are on the use of wire for electrical purposes, wire ropes and miscellaneous uses, the whole forming a very complete and comprehensive treatise on the subject of wire generally. The book is a large 8vo, of 347 pages, and is published by the office of *Engineering*, London, and John Wiley & Sons, New York.

The New Albany is the name of a monthly journal which has already appeared three times. It is published by the Brandow Printing Company, of Albany, N. Y. It seems to have for its main purpose the pushing ahead of Albany interests, and to that end secures the views of able writers on the subject. The numbers so far contain a considerable number of illustrations, and it is taking to itself more pages. We hope it will bring about a healthy boom in Albany matters. The subscription price is fifty cents a year.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(400) J. C. S., Baltimore, Md., writes: Please state where I can get Prof. Olney's geometry, algebra, and elements of arithmetic, and prices of the same. *A.*—The names of the publishers of these books are given in answer to Question 380, in our issue of August 20th. For prices write to the publishers.

(401) G. H. B., Auburn, Ala., writes: Please inform me through your paper where I can find a list of the numbers of gauge thicknesses of sheet-iron as used now by iron workers in this country, with the list of their equivalents in inches. *A.*—You will find them in Haswell's Engineers' and Mechanics' Pocket-book, Trautwine's Civil Engineers' Pocket-book, and many other good works on engineering.

(402) J. C., Toronto, Canada, writes: Please publish some sketches of the working parts in the front of an engine lathe. I am going to make one myself, and would like to know the best movements. *A.*—We have no sketches on hand to publish. There are so many good lathes in use almost everywhere, that it seems to us you should not have much trouble of becoming familiar with all the details of a lathe, and your own observations of the actions of the different lathes should enable you to make your own designs.

(403) C. C., Birmingham, Conn., writes: Please inform me where, in your opinion, a young man can make the most of five or six hundred dollars to take a course in mechanical or civil engineering. *A.*—A course in mechanical engineering will require more than the amount named. Under these conditions we should advise you to take private lessons at such times as will not prevent you from earning sufficient to pay your expenses. Or make an arrangement with some technical institute which will enable you to take part of a course at a time, and earn more money during the intervals. Or if there is in your locality a school like the Cooper's Institute in New York, join it and save as much of your money as you can.

(404) C. W. H., Swanzey, N. H., writes: Please inform me how spiral springs are made to give them a "set" or "initial tension," by which they require a greater load to pull them out the first ¼ of an inch than for the succeeding ones. For example, I have a spring that requires 95 pounds to pull it out the first ¼ of an inch and each 35 pounds will pull it out ¼ of an inch further. *A.*—We have inquired of spring makers, but failed to obtain satisfactory answers. Undoubtedly special machines are used for the purpose, and the initial tension is produced by a peculiar process of rolling. We do not know whether the process is patented or whether it is a trade secret; if not, we should be pleased to hear from some of our readers on the subject.

(405) L. G. S., Lima, Ohio, writes: Please inform me as to the rule by which I can find the distance between eccentric rod pins in Stephenson's links. For instance, the travel of the valve is 2 inches; link radius, 35 inches; what should be the distance between the eccentric rod pins in the link? *A.*—There is no regular rule for finding this distance; the usual practice is to make it equal to 2¼ to 2⅓ times, and occasionally to 3 times the throw of the eccentric. If the travel of the valve is equal to the throw of the eccentric, then we should make the distance between the centers of the eccentric rod pins equal to $2 \times 2\frac{1}{2} = 5$ inches. This distance should not be much less than here given, because that will increase the slip of the link on the block; and on the other hand the design of the engine, and the conditions under which it has to be worked, may not permit a greater distance.

(406) C. F. F., Parkersburg, W. Va., writes: I have just read in your paper the advice you give to young men who wish to study drafting, etc. I have been looking for something like that for a long time, and your article fits my case exactly. Kindly tell me about what size drawing board I will require, and the probable cost of instruments. *A.*—We should recommend a drawing board 28 inches long and 21 inches wide; T square, 28 inches long; set square, 13 inches long, containing the angles of 90, 60 and 30 degrees; and one set square containing the angles of 90 and 45 degrees, the sides about 8 inches long. For a fuller description of these tools see our issues November 20, 27, 1886. The instruments have been illustrated in our issues of December 4, 1886, and February 19, 1887. The prices vary according to quality; we should advise you to buy good ones; about $20 we consider to be a fair price for the set. This does not include the drawing board and squares, which may cost about $2.50.

(407) W. M. L., Brooklyn, N. Y., writes: In the AMERICAN MACHINIST I saw the following passage: "I consider a knowledge of practical, plane and solid geometry and machine drawing and construction as necessary qualifications in a good mechanic," etc. Now, wishing to be a good mechanic, and not having a knowledge of the above, can and will you inform me where I can get books on each subject; their names and prices? *A.*—See article treating on "What to Study," in our issue of February 19th, current volume; for the publishers' names see answer to Question 380, in our issue of August 20, current volume. None of the elementary text-books will cost more than $2, some of them less. Some of the books treating on the higher branches of engineering cost as much as $6 each. 2. Please give name of a book treating on lathes and lathe work. *A.*—We do not know of a book that covers these subjects thoroughly; probably "Turning Lathes": A manual for technical schools and apprentices, by James Lukin, B. A., may suit you.

(408) K., Buffalo, N. Y., writes: Please give me a rule for finding the diameter of piston rod. *A.*—The diameter of a piston rod may be found by the following rules: When a single piston rod is used for a cylinder, divide the diameter of the cylinder in inches by a constant of 60, and multiply the quotient by the square root of the absolute steam pressure; this product will be the diameter of the rod in inches. By absolute pressure we mean the boiler pressure plus 15 pounds. When two piston rods are used, the same rule is employed, excepting the constant, which should be 80 in place of 60. These rules may be expressed by symbols as follows: Let D denote the diameter of the cylinder in inches; P the absolute steam pressure, and d the diameter of the piston rod in inches. Then we have, for single piston rods,

$$d = \frac{D}{60} \times \sqrt{P}$$

and for double piston rods,

$$d = \frac{D}{80} \times \sqrt{P}$$

Example: What should be the diameter of a single piston rod for a cylinder 16 inches diameter? The boiler pressure is 66 pounds. The absolute pressure will be $66 + 15 = 81$ pounds. Now substituting for symbols their values, we have

$$d = \frac{16}{60} \times \sqrt{81} = \frac{16}{60} \times 9 = 2.4 \text{ inches.}$$

The foregoing rules are generally used for condensing engines, and for piston rods of the ordinary length; that is, for piston rods whose length is equal to 7 or 8 times the diameter of the rod. When the piston rods are very long, say from 10 to 15 diameters and over, it is better to use a constant of 45 in place of 60. The constant 45 should also be used for piston rods in oscillating engines. For non-condensing engines, some engineers take the square root of the boiler pressure in place of the square root of the absolute pressure in the foregoing formulas. 2. Please give me a rule for laying out a common slide valve; or, if you have already published it, in what paper can I find it? See our issue of May 1, 1890, page 5.

(409) W. B. C., Waterbury, Conn., writes: I am about to build a compound engine, high pressure cylinder will be 6 inches diameter; stroke, 6 inches; initial steam pressure, about 60 pounds; revolutions per minute, 500. Kindly give me the proper size of the low-pressure cylinder. In one of your issues, speaking of a triple-expansion engine, you gave a rule which was 1½ times the diameter of the high-pressure cylinder for the intermediate cylinder, and 2½ times the diameter of the high-pressure cylinder for the low-pressure cylinder. In another issue relating to a small yacht engine you gave 2⅜ inches diameter for the high-pressure cylinder, and 5½ inches diameter for the low-pressure cylinder. If it is not asking too much, will you please explain why in one case you compute the size of cylinder 1½ times, and in the other case twice the size of the high-pressure clinder? Please give rule to compute the size of low-pressure cylinders when the diameter of the high-pressure cylinder is given. Also give a rule to find the proper diameter of steam pipes for these engines. *A.*—You overlook the fact that the yacht engine is a compound engine, and the rule to which you refer relates to triple-expansion engine; you will also notice that in giving this rule in answer to Question 308, in our issue of July 9, current volume, we have stated that there are several rules for computing the diameters of the cylinders; and the chief point at issue between rival engineering establishments, as well as between engineers generally, is as to what is the best ratio of cylinder capacity. For compound engines the rule in general use is to make the cylinder ratio equal to the total ratio of expansion, multiplied by the decimal part of the stroke completed by the small piston when the steam is cut off in its cylinder. For instance, if the engine you intend to build is non-condensing, the ratio of expansion will probably be about 4; if now steam is cut off in the high-pressure cylinder at ½ stroke then the cylinder ratio will be $4 \times .5 = 2$; that is to say, the area of the large cylinder should be twice that of the small one. In your engine the area of the 6-inch cylinder will be 28.27 square inches, hence the area of the large cylinder should be $28.27 \times 2 = 56.54$ square inches; the corresponding diameter will be 8½ inches nearly. If, on the other hand, the engine is to be a condensing one, the total number of expansions will probably be 11, and if steam is cut off at $\frac{3}{10}$ stroke, then the cylinder ratio should be $11 \times .3 = 3.3$; that is to say, the area of the large cylinder should be 3.3 times that of the small one. Hence under these conditions the area of the large cylinder in your engine should be $28.27 \times 3.3 = 93.291$ square inches; the corresponding diameter will be 11 inches nearly. For finding the diameters of cylinders for a triple-expansion engine we must refer you to the answer of Question 308. The area of the steam pipe should be $\frac{8}{10}$ of the area of the steam ports. The area of the steam port is found by multiplying the square of the diameter of the cylinder in inches by the speed of piston in feet per minute, and dividing the product by the constant 7,639; the quotient will be the area of each steam port in square inches.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

George B. Grant—Gear Wheels. See p. 30.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

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Ice and Refrigerating Machines, 170 sold, and all successful. David Boyle, 521 Monroe St., Chicago, Ill.

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Wrist-Pin Machines. Pedrick & Ayer, Philadelphia, Pa.

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Our Automatic Gear Cutting Machine will increase production 50%. The Superior Mach. Wks., Clev'd, O.

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Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For the latest improved Eccentric Hook, Connecting Rods and Stub Ends, address T. C. Dill Machine Company, Philadelphia, Pa.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

Save small iron from foundry refuse. It pays. Use the Woodruff Pat. Separating Machine, Audubon Machine Works, New Haven, Conn.

"Twenty Years With the Indicator," by Thomas Pray, Jr. 10,100 sold. Price, $2.50. Order of bookseller; take no other.

Hyd. press, hyd. jacks, steam tables, accumulators, cutting and stamping dies for sheet metal, foot press, etc. S. Hartley, 245 N. J. R. R. Ave., Newark, N. J.

Self-adjusting Hand-Screw for Pattern and Cabinet Makers, Wood Workers, etc. Sample by mail for 50 cents. Wm. H. Denney, Lancaster, Pa.

Upright Drills and Iron Planers, for immediate delivery; prices reasonable. J. E. Snyder, Worcester, Mass.

Our catalogue of books for engineers and machinists, mailed free to any address. Norman W. Henley & Co., 150 Nassau Street, New York.

25" / 32" / 37" / 42" — "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, Newark, N. J.

The Corliss Engine, by John T. Henthorn: A Manual especially adapted for every-day use. $1, free by mail. Egbert P. Watson & Son, 150 Nassau street, New York.

DuBois & DuBois, Patent Attys., 715 11th St., Washington, D. C., procure first-class patents. Send stamp for illustrated pamphlet, "March of Invention," containing valuable information, and list of references.

Do you wish to become an expert engineer? Hawkins' Hand Book of Calculations will greatly aid you. 10 parts, 25 cents each, or in 1 volume, $2.50. Catalogue. Theo. Audel & Co., Publishers, 91 Liberty St., New York.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo., cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt St., New York.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York

MANUFACTURES.

A new knitting factory is to be established at Frostburgh, Md.

The establishment of a lock factory at Corsicana, Tex., is talked of.

The Dilley foundry, at Palestine, Tex., has resumed operations.

The Rich Patch Iron Company, Low Moor, Va., is to double its capacity.

T. S. Rogers is reported as erecting a fertilizer factory at Tarboro, N. C.

John Adt & Son have just completed a new foundry at New Haven, Conn.

The Upson Nut Company, of Unionville, Conn., is to build a new boiler-house.

W. C. Mayes and S. W. Strait are to erect a cotton factory at West Greene, Ala.

The capacity of the Cordele (Ga.) electric light plant is reported as to be doubled.

A foundry and machine shop is to be established at the State University in Lexington, Ky.

Philadelphia (Pa.) parties will, it is reported, establish aluminum works near Bryant, Ala.

Northern capitalists are investigating with a view to erecting smelting works at Roanoke, Va.

Lanark, Ill., is to have a woolen-mill, $7,000 of the stock of a $12,000 company having been subscribed.

The Brooklyn Railway Supply Company, Mianus, Conn., is to erect a new factory building.

Messrs. Green and Manly are reported as erecting new iron foundry and machine shops at Dalton, Ga.

The Augusta (Ga.) Cotton Factory is to put new machinery in its mill, and will enlarge its buildings also.

The machine shops of G. H. Osbourn, at Clarksburg, W. Va., recently burned, will be rebuilt at once.

The Stratton Ice Works (Pensacola, Fla.,) will put in new ice machine; will also put in electric light plant.

A. M. Grist, Yorkville, S. C., contemplates putting in a plant with capacity for 30 incandescent lights.

The Gilbert Clock Company, of Winsted, Conn., has broken ground for another building, 40x60 feet in size.

The Excelsior Iron Works, Chicago, Ill., will erect a five-story machine shop, 74x91 feet, at a cost of $40,000.

Saunders' Cotton-mills, Saundersville, Mass., are making some improvements in their plant and machinery.

The Missouri Pacific has begun the work of rebuilding the shops at Cypress, in Kansas, near Kansas City.

Leonard & Cornell, boiler makers, of Jackson, Mich., contemplate removing their works to Elkhart, Ind.

The Thorndike Cotton Company is to build an addition to the picker house at Thorndike, Mass., 40x70 feet.

The Shawhan Electrical Works, a new industry at Concord, Mass., will start up soon with twenty-five hands.

The West Superior Iron and Steel Company, at West Superior, Wis., will soon inaugurate the making of steel.

A cotton-mill is to be erected at Lafayette, Ga., by A. R. Steel and others. It will be known as the Union Mill.

The Grand Haven Electric Light and Power Company, Grand Haven, Mich., has been incorporated; capital, $10,000.

It is stated that a $150,000 stock company is being organized, to establish a manufacturing enterprise in Orlando, Fla.

The Southern Engine and Boiler Works Company, Jackson, Tenn., will build a new boiler house 65x100 feet in size.

The Lowell (Mass.) Steam Boiler Works, recently destroyed by fire, are to be rebuilt at once on a much larger scale.

J. F. Brown & Co., proprietors of the Ronceverte Wheel Company, will erect a wheel factory at Ronceverte, W. Va.

It is reported that the Central Railroad of Georgia will put new machinery in its machine shops at Macon, Ga.

Operations at the new works of the Rolled Steel Wheel Company, at Kensington, Pa., may be commenced by October.

The erection of an electric light plant is being discussed at Franklin, Ky. M. S. Harris, mayor, can give particulars.

The North Highlands Electric Railway Company, Columbus, Ga., will build a power plant to operate its electrical railway.

The sheet-mill of the Reading Iron Company, of Reading, Pa., has shut down for repairs. An addition 80x100 will be erected.

Forty-one carloads of machinery have been delivered at Blaine, Pa., for the new safe and lock works being erected there.

It is stated that a stock company is being organized to build a cotton-mill at Concord, N. C., and $75,000 has been subscribed.

Plans are being prepared by the American Tube and Iron Company to extend its Youngstown plant and increase the production.

Report has it that the South Tredegar Iron Works, Chattanooga, Tenn., will pass into other hands and the plant be greatly improved.

Philadelphia (Pa.) parties will erect aluminum works near Bryant, Ark., as recently reported; work to commence October 1st.

A stock company is being organized to erect an ice factory at Chickamauga, Ga. E. Van Winkle, of Atlanta, can give information.

D. C. Ebaugh, of Greenville, S. C., has made a proposition for the organization of a $100,000 stock company to erect a fertilizer factory.

The Low Adjustable Car Company, of Chicago, Ill., with a capital stock of $1,000,000, has been incorporated by H. N. Greene and others.

The American Car Company, of St. Paul, Minn., has been incorporated by W. Rutton, Emil Alexander, T. Papin, Jr., with capital stock of $100,000.

The Hanover Machine Works have been organized, with a capital stock of $100,000, at Frederick, Md., for the purpose of manufacturing machinery.

The Chattanooga (Tenn.) Elevator Manufacturing Company will, it is reported, put new machinery in, and increase the capacity of its elevator works.

The J. W. Porter Boiler and Tank Company, of Pittsburgh, formerly the Carroll-Porter Company, have increased their capital stock from $50,000 to $100,000.

The Great Northern contemplates the erection of a building designed to embrace a testing laboratory and a brass foundry, to be located at the St. Paul shops.

J. W. O'Meara, F. G. Dietrich, J. M. Bradley and others have incorporated the Automatic Machine Company at Washington, D. C., with a capital stock of $250,000.

The Upson Nut Company at Unionville, Conn., will build a brick engine-house, to be located between the office and forging-room, and near the hose-house.

The Chattanooga Saw Works, which purchased the Piedmont (Ala.) Foundry and Machine Works, will sell the plant as it stands or move it to Chattanooga, Tenn.

It is thought that arrangements will be made whereby the Muncaster-McKaig Iron and Steel Shafting Works will be removed from Cumberland, Md., to Youngstown, O.

It is stated that R. D. Smith & Co., of Birmingham, Ala., have leased the iron furnance of the Birmingham Furnace and Manufacturing Company, at Trussville, Ala.

The Wormer Machinery Company, St. Louis, has been incorporated; capital, $3,000. The stockholders are Theo. K. Wormer, Alfred M. Shepard and Frank Hargensieker.

A large plant will probably be erected at Chelsea, Mass., by the George W. Sweet Steel Car Wheel Company. The plans call for an 86x84 brick machine shop and foundry building.

The Belfast Machine and Foundry Company, recently organized in Belfast, Me., is well under way and doing good business. Work on their new foundry is progressing rapidly.

In connection with the Dennis & Roberts machine shop at Watkins, N. Y., E. H. Spicer intends to establish a molding plant. A cupola will be built and castings of all kinds produced.

The president of the Bessemer (Ala.) Pipe Works has said that his company will double the present capacity of that plant in the near future. The pay-roll now numbers about 600 men.

The Beecher Bolt Threading Machine Company, of Chicago, is a new incorporation, with a capital stock of $100,000. The incorporators are: J. A. Beecher, G. W. Gale and J. E. Harder.

A new mill for merchant bar-iron will be constructed at Anniston, Ala., by the United States Rolling Stock Company, which now has fourteen puddling and heating furnaces in operation.

Much of the machinery for the armor plate-mill of Carnegie, Phipps & Co., at Homestead, Pa., has arrived, and been placed in position. The manufacture of these plates will not be long delayed.

The Rockingham Combination Slat and Wire Fence Machine Company has been incorporated at Harrisonburg, Va., to manufacture and deal in slat and wire fence machines; capital stock, $50,000.

Plans have been prepared for the horse-nail works to be erected on Van Rensselaer Island at Greenbush, N. Y. The main building measures 52x208 feet, and will have a truss roof, covered with slate.

Messrs. Naylor & Co., of Pittsburgh, Pa., have leased the Sharon (formerly Vernon) Furnace, at Sharon, Pa., and will overhaul and modernize it. The furnace will be started up the first of October.

The contract has been closed by which the Wright steel shovel works are to locate in Anderson, Ind. This factory was located in Beaver Falls, Pa. After removal, it will give employment to about 150 men.

The Columbia Horseshoe Nail Company's new plant at New Milford, Ill., is completed, with the exception of placing the machinery in place, which will be done at once and the plant put in operation within 30 days.

The Courtwright Manufacturing Company, of Detroit, manufacturer of railroad hand cars and other supplies, will soon remove its works to Benton Harbor, Mich., where land has been purchased for new works.

It is stated that a Sheffield (England) manufactory, with $2,000,000 of capital, is desirous of removing its plant to some point in the South, and that negotiations are to be commenced to locate it in Chattanooga, Tenn.

The Chicago Equipment Co. has been formed, to manufacture and deal in cars, locomotives, rails and all kinds of railroad supplies; capital stock, $1,000,000; incorporators, R. H. Pugh, R. Willbe force and H. S. Monroe.

The Peoria Fence Company, of Peoria, Ill., was organized on the 19th inst., for the purpose of manufacturing and selling a combination wire and iron fence. Frank Garthuvit and Martin V. B. Cumetford are the incorporators.

The Duquesne Tube Works Company, which recently erected large additions to its plant at Duquesne, Pa., has decided to increase the capital stock from $100,000 to $150,000, and will shortly add a rolling-mill to its capacity.

The Cincinnati Corrugating Company, Piqua, Ohio, has issued a very neat circular, showing what it makes in the way of corrugated metals for roofing and building purposes generally. The catalogue is an interesting one.

We have received from Jules Derriey, of Paris, a catalogue of printing machinery, embracing presses in a great variety, both power and foot-presses. A large number of letters attest to the estimation in which the presses shown are held.

It is reported that the plant of the Solid Steel Works, at Alliance, Ohio, will be extended so as to double the capacity of the present works. The rapidly increasing business of the company renders it necessary to enlarge their facilities.

The Chattanooga Saw Company has, it is reported, purchased the Piedmont Foundry and Machine Company's plant at Piedmont, Ala., and will remove same to Chattanooga, Tenn., organizing a $100,000 company to put it in operation.

A new company, to be known as the Clark Cutaway Harrow Company, has been formed at Higganum, Conn., to succeed the defunct Higganum Manufacturing Company. The capital stock is to be $50,000, divided into 2,000 shares of $25 each.

A company, of Providence, R. I., has had representatives in Anderson, Ind., looking for a suitable site for the erection of its steel works. The product of the factory will be steel goods of various kinds, and will give employment to about 500 men.

A new company, to be known as the Windsor Company, has been organized at North Adams, Mass., to succeed the Freeman Manufacturing Company and start up the works. The corporation was organized under the laws of New Jersey.

There is a probability that the steel works of the Colorado Coal and Iron Company, at Bessemer, Col., will start up in the near future. New engines and cranes are being erected, and arrangements have been made for the introduction of gas as fuel.

The American Fertilizing Company, of Norfolk, has, it is stated, purchased property at Gosport, Portsmouth, Va., and will move its entire plant to the site. A building two stories, 150x100 feet, with a tower 40 feet square, will, it is said, be erected for the works.

The Minnesota Iron Car Company, who failed several months ago, has passed into the hands of the Duluth Manufacturing Company, a new corporation just formed under the laws of New Jersey, with a capital of $1,250,000. The works already have orders for 1,000 cars.

The Baltimore & Ohio Railroad Company has secured 65 acres of land at Cumberland, Md., upon which to erect shops and establish freight yards. The shops at Keyser, Piedmont and Martinsburg will be moved to Cumberland when the shops at the latter place are completed.

The contract for the Boston and Montana Copper Company's new steel buildings at Great Falls has been awarded to the Berlin Iron Bridge Company, of East Berlin. The machinery for the smelter is to be supplied by Fraser & Chalmers. The contract price for the buildings is said to be $58,000.

The Florida Fiber Company, Jacksonville, Fla., capital, $40,000, owns 1,310 acres near Fort Lauderdale, in Dade County. On this land it has put out 200,000 sisal plants which it is now cultivating, and at the same time it is procuring its machinery for fiber making, and is building houses and shops.

John S. Cleland, W. J. Kiskadin and others, of Pittsburgh, will make application for a charter for an intended corporation, to be known as the National Separating and Manufacturing Company, of Pittsburgh, the character and object of which is the manufacture of iron and steel, and other metals.

The Attalla Iron and Steel Company, Ala., proposes to finish and put in operation the buildings, etc., of the Attalla Foundry Company, upon which it has an option. It has closed a contract with W. G. Lunsford, of Birmingham, for two blocks of property for the purpose of erecting a foundry and machine shop.

Messrs. G. P. Putnam's Sons, publishers, of West Twenty-third street, New York, have purchased, through Charles Field Griffen & Co., a tract of land at Mamaroneck, N. Y., near the station, on which they contemplate the erection of a large factory building for the uses of their business. They will employ about 200 hands.

The Essex Iron Company, of New York, recently incorporated with the State Department, have filed a certificate setting forth that their capital stock, $25,000, has been subscribed for as follows: Wm. H. Searles, 520 shares; Otis H. Cutler, 5 shares; J. M. Lewis, 50 shares; Romeo T. Betts, 50 shares; Gustav Lindenthal, 625 shares.

Messrs. English, Morse & Co., of Kansas, Mo., manufacturers of steam and hydraulic machinery, tools and supplies, have dissolved partnership, Mr. A. H. Morse retiring from the business. The English Supply and Engine Company has been incorporated, with a capital of $50,000, and will succeed the firm of English, Morse & Co.

The Curran Oil saving Bearing Company, of Chicago, has been incorporated, with capital stock of $100,000. The company will manufacture an oil-saving bearing for car journals and other machinery. Wm. Curran, R. T. Bertelsen, Herman Lorenz, August C. Glover and Friedrich Roehl are the stockholders of the company.

The West Albany shops of the New York Central & Hudson River Railroad, West Albany, N. Y., which were burned last May, are nearly rebuilt. The roof will be of iron, and is being made by the Hilton Bridge Company, Albany, N. Y. A large amount of new machinery and tools is to be purchased for the renewed car shops.

The Alabama Rolling-mills Company, of Gate City, Ala., is pushing the work of rebuilding its plant very rapidly. The property was almost totally destroyed by fire a few weeks ago. The new mill will be increased in capacity by the addition of seven puddling furnaces. Operations will begin again about the 1st of September.

The Alabama Rolling-mills plant, at Gate City, Ala., is being rapidly rebuilt, and it is expected that work can be resumed on or about the 1st prox. Many improvements will be made in the plant, which will also be enlarged to the extent of seven puddling furnaces. These mills, it will be remembered, were recently destroyed by fire.

The interest in the proposed new $1,000,000 steel plant at Ensley, Ala., is increasing, and it is now almost certain that it will be secured. Over $600,000 has already been subscribed to the enterprise, and Mr. T. J. Hillman, the president of the company, has been assured that the remaining $400,000 can be obtained. Birmingham has subscribed about $300,000.

W. J. Fitzsimmons, secretary Board of Trade, writes that four large industries have made a proposition to the Land Company to locate their plants at Newport News, Va., and a steel plant is believed to be among the number. A cutlery factory to employ 500 men is also said to be included. The Old Dominion Land Company (C. B. Orcutt, president,) 1 Broadway, New York City, can give information.

At the Boston Iron and Steel Company's plant, at McKeesport, Pa., a new puddle-mill, of about 30 furnaces, with necessary muck rolls and hammers, has been started up. When placed in full operation it will employ about 300 men. Work has already been commenced on a big finishing department for the mill, which is now under the control of the newly organized National Tube Works Company.

The works of the Henry C. Hart Manufacturing Company, at 492 Franklin street, Detroit, were burned on the evening of the 13th inst. The loss is estimated at over $100,000. The company will rebuild at once, but for the present will probably be obliged to have a portion of their orders filled outside. The "Standard" car water closet is made by this firm, as well as brass railings for car interiors and other light railway supplies.

The Columbia Steel Car Company has been reorganized, Mr. B. F. Holmes and a number of New York railroad men having purchased a controlling interest. The Columbia Car Company controls a large tract of land at Riverview and Revere Park, about a mile south of Desplaines, Ill., and is building an extensive plant for the manufacture of steel cars. The buildings now under way comprise an erecting shop, blacksmith shop and wood and paint shops.

C. W. Osgood & Son recently dedicated their new machine shop at Bellows Falls, Vt. The shop is one of the best machine shops in Vermont. It is 260 feet long and 60 feet wide, and is built after the modern models of machine shops. It is of brick, finished inside in white to increase the light, and all the work is of the most substantial character. The firm has begun to move their machinery from the old shop, and expect to be settled in the new factory early in September.

The Great Western Iron and Steel Works are rapidly pushing the building of the blast furnace and works at Kirkland, Wash. The blast furnaces will be 75 feet high, with a 17-foot bosh, and will have a capacity of 1,100 tons of pig-iron per week. The hot-blast stoves will be 72 feet high and and 26 feet in diameter, of the Ford & Moncur pattern. The two blowing engines have steam cylinders 42 inches in diameter, 5-foot stroke, and will be capable of developing 1,500 H. P.

Richard Dobbins, proprietor of the Lowell (Mass.) steam boiler works, which were burned out recently, has had his insurance adjusted, and will immediately commence to rebuild. The new shop will be built upon the same lines as the other, only it will have 1,000 feet more floor room, an addition made necessary by the increasing business. That portion of the shop where the forges are, and the boiler-room, will be built of brick. Instead of the old iron stack there will be built a substantial brick chimney.

James J. Hill's residence at St. Paul, Minn., is to be lighted by electricity furnished by what is said to be one of the largest storage batteries in existence. The installation will comprise 600 cells in sixty series of ten each, which will give storage capacity for running 650 sixteen candle-power incandescent lamps for ten hours. The power for this plant is to be supplied by a sixty-four horse-power air engine, which is now being built by The Ticonderoga Machine Company, of Ticonderoga, N. Y. Few are aware of the fact that air engines of this high capacity are obtainable. The inventors of this machine having perfected it, are now putting it on the market. For this engine the claim is made that it runs on less than one half the fuel that the ordinary steam engine and boiler of equal capacity require, and that it is perfectly free from danger of explosion, using no boiler. It is noiseless, having no exhaust or blow-off.

The *National Democrat*, of Cassopolis, Mich., has the following: A largely attended meeting was held in the court house Tuesday evening to consider the question of the desirability and advisability of the village of Cassopolis constructing a system of water-works. S. T. Read was called to the chair, and G. M. Kingsbury appointed secretary. There was but little discussion of the subject, all who did speak, however, agreeing as to the desirability of some system of water-works which would furnish an abundant supply of water to make an efficient fire protection for the whole village. The question of its cost, and the desirability of the village incurring the indebtedness, was not discussed. G. M. Kingsbury, M. L. Howell and C. A. Ritter were appointed a committee to ascertain the probable expense of laying the necessary pipes, and putting in a pumping plant, and what the annual expenses of keeping the plant running would be, and also what revenue from water users might reasonably be looked for. The committee was instructed to report at a meeting to be called by the president when the committee is ready to report.

The Effect of Heat on the Strength of Materials.

(From an article published in Industries.)

The effects of low temperatures on the mechanical properties of iron and steel appear to have received rather more attention than those of high temperatures. On February 10th, 1880, a paper was read by Mr. John James Webster, before the Institution of Civil Engineers, on "Iron and Steel at Low Temperatures," in which, before recounting his own experiences, the author gives a brief account of the work done by previous investigators in the same direction.

The most elaborate and careful experiments of this kind on record are those by Mr. Knut Styffe, Director of the Royal Technological Institute at Stockholm, carried out in 1865 for the information of a Swedish government committee. The following conclusions were arrived at by Mr. Styffe:

(1) "That the absolute strength of iron and steel is not diminished by cold, but that even at the lowest temperature which ever occurs in Sweden it is at least as great as at the ordinary temperature (about 60° Fahr.)"

(2) "That at temperatures between 212° and 392° Fahr. the absolute strength of steel is nearly the same as at the ordinary temperature, but in soft iron it is always greater."

(3) "That neither in steel nor in iron is the extensibility less in severe cold than at the ordinary temperature; but that from 266° to 320° Fahr. it is generally diminished, not to any great extent, indeed, in steel, but considerably in iron."

(4) "That the limit of elasticity in both steel and iron lies higher in severe cold; but that at about 284° Fahr. it is lower, at least in iron, than at the ordinary temperature."

(5) "That the modulus of elasticity in both steel and iron is increased on reduction of temperature, and diminished on elevation of temperature; but that these variations never exceed 0.05 per cent. for a change of temperature of 1.8° Fahr. and therefore such variations, at least for ordinary purposes, are of no special importance."

Mr. C. P. Sandberg, from whose translation of Mr. Styffe's report the above is quoted, made in 1867 a number of tests of iron rails at various temperatures by means of a falling weight, since he was of opinion that, although Mr. Styffe's conclusions were perfectly correct as regards tensile strength, they might not apply to the resistance of iron to impact at low temperatures. Mr. Sandberg convinced himself that "the breaking strain" of iron such as was usually employed for rails, "as tested by sudden blows or shocks, is considerably influenced by cold; such iron exhibiting at 10° Fahr. only from one third to one-fourth of the strength which it possesses at 84° Fahr." Mr. Webster, however, in the paper to which we have previously referred, gives reasons for doubting the accuracy of Mr. Sandberg's deductions, since the tests at the lower temperature were nearly all made with 21 ft. lengths of rail, while those at the higher temperatures were made with short lengths, the supports in every case being the same distance apart.

We now come to Mr. Webster's own researches in this field. The materials tested were wrought-iron, cast-iron, Bessemer steel, best cast steel, and malleable cast-iron. Three series of experiments were directed to ascertaining, respectively, the tensile strengths, transverse strengths, and resistance to impact of the materials at temperatures of 50° and 5° F. The transverse tests were confined to cast-iron. The results of the tensile tests on wrought-iron and steel agree generally with those observed by Mr. Styffe, and show clearly "that severe cold does not affect the tensile strength of the materials, but that it increases the ductility of each of them" to the extent of 1 per cent. in iron and 3 per cent. in steel.

Mr. Webster found, further—(1) "that when bars of cast-iron are submitted to a transverse strain at a low temperature, their strength is diminished about 3 per cent. and their flexibility about 16 per cent."; (2) that "when bars of wrought-iron, malleable cast-iron, steel, and ordinary cast-iron are subjected to a force of impact at a temperature of 5° F., the force required to break them and the extent of their flexibility are reduced as follows, viz.:

	Reduction of Force of Impact.	Reduction of Flexibility.
Wrought-iron	About 3 per ct.	About 18 per ct.
Steel (best cast steel)	" 1 "	" 17 "
Malleable cast-iron	" 4½ "	" 15 "
Cast-iron	" 21 "	not taken."

The Bessemer steel tested by Mr. Webster was of a harder quality than that used in the German experiments which we have described, the former having a breaking strength of about 46 tons per square inch, with an elongation of at most 18.8 per cent. in 6¼ in., while the hardest quality of the latter had an ultimate stress of about 30.5 tons per square inch, and an elongation of over 26 per cent. in a length of about 8 in. (equivalent to rather more in 6¼ in.)

The experience of railway engineers in Russia, Canada, and other countries where the winter is severe is that the breakages of rails and tires are far more numerous in the cold weather than in summer. On this account a softer class of steel is employed in Russia, and, we believe, in Sweden, for rails, than is usual in more temperate climates.

The evidence extant in relation to this matter leaves no doubt that the capability of wrought-iron or steel to resist impact is reduced by cold. On the other hand, what, for the sake of convenient distinction, may be termed its *static strength*, is not impaired by low temperatures. The former fact is chiefly of importance in connection with railway material, the latter is reassuring as regards the safety of all structures not liable to sudden shocks. There is obviously scope for further scientific investigation, both as to the effects of cold and heat on materials of construction; more especially, it seems to us, would more precise information be welcome on the manner in which the behavior of steel at different temperatures varies according to its quality. We are glad to learn that it is the intention of the German technical societies named at the outset to continue the researches, of which we have noticed the first installment.

It seems extremely probable that some connection will be found to exist between the phenomena to which we have just referred and those observed by M. Osmond, and described in his paper on "The Critical Points of Iron and Steel," read before the Iron and Steel Institute on May 7th, 1890 (see *Industries*, Vol. VIII, page 446). M. Osmond, it may be remembered, found that at certain temperatures sudden alterations taking place in the physical properties of iron and steel are indicated by changes in the rate of cooling (or heating). That such changes must correspond to modifications in the strength and elasticity of the materials is a very plausible hypothesis, the confirmation of which would add another contribution to the ever accumulating mass of evidence showing the intimate relationship existing between different branches of science, and more especially between physical and chemical science.

How Natural Gas Goes.

An Indianapolis dispatch says:

"Further disclosures are made as to the diminution of the supply of natural gas in the Indiana field. The present supply for the city of Indianapolis is obtained from a new set of wells, and it is necessary continually to open new ones. Experience has proved, according to the published figures, that the average life of a well, when drawn upon continually, is about three years. In the beginning the supply was obtained at a point in the field twenty miles distant from Indianapolis. Now it is necessary to bring the gas a distance of nearly forty miles, and the wells are now within a few miles of the heart of the field.

"These facts are disclosed to enforce economy in the use of the fuel, and to secure the introduction of the meter system, instead of permitting consumers to burn all the gas they want for a fixed yearly charge. There is great waste in the manufactories."

Moderately Cheap Gas.

A Cleveland, Ohio, dispatch says:

In the local gas fight over the ordinance reducing the price of gas to 60 cents per thousand, the city won in the first round in the Circuit Court yesterday. The gas companies had brought an injunction suit to forbid the city government's publishing the ordinance, publication under the law being necessary to validity. The court decided in the city's favor, and speculation is now rife as to what step the companies will take next. The ordinance was published this morning and is now in effect, and September bills will have to be made out at sixty cents. The city's case has been admirably managed by Corporation-Counsel Meyer, and the chances of the companies breaking down the ordinance seem very small.

New Sound Steamers.

The Providence and Stonington Steamship Company will add two magnificent new steamers next summer to their present splendid fleet. They are being built by the Harlan & Hollingsworth Company, of Wilmington. They will be propelled by screw instead of side wheels, and will be the most luxurious steamers that have ever floated on the Sound.

For speed, safety, capacity, comfort and beauty the new vessels will far surpass the magnificent side-wheel boats of the present. The dimensions of the steamers will be: Length on water line, 302 feet; length over all, 310 feet; beam deck, 45 feet; over all, 60 feet; depth of hold, 17½ feet. All the plates in the hull are to be of steel, having a tensile strength of from 60,000 to 68,000 pounds. Each boat will be furnished with four Scotch boilers of 60,000 pounds steel, and capable of sustaining a bursting pressure of 160 pounds.

The vessels will make a speed of seventeen miles an hour with 400 passengers and 600 tons of freight aboard. Both boats will be well equipped with the modern conveniences for lighting, heating, and supplying water. A peculiar feature will be the gallery deck over the promenade deck forward, where will be located a dining room, a smoking room and a barber shop, commanding an unobstructed view, inviting the coolest breezes and presenting the pleasantest prospects.—*The Press.*

Camels' Hair Belting.

One of the latest things in the way of a belt in this country, though it is more familiar in England, is belting made of camels' hair. The first thought of the mechanic who has had experience in buying a camel's hair shawl for his wife, and paying five or six hundred dollars for it, is that camel's hair is altogether too expensive a material for belts; but we are informed that this depends upon what particular kind of hair is selected, and that some kinds of camel's hair, that is, hair which comes from certain parts of the body, is not so expensive as to prohibit its use for this purpose. Among the advantages claimed for the belts are, they are absolutely uniform in strength and elasticity at either surface or at either edge, so that they run true and smoothly; have only one joint in them, which can be made as good and smooth as any other part of the belt; it is stronger than leather belting, and more durable; its adhesion is better, and it is adapted to use in exposed places where it is liable to become wet. At present the only manufacturers of this belting in this country are the Rossendale Belting Company, Euclid avenue, Newark, N. J.

Recent thunder-storms have confirmed the old saying that it is dangerous to stand under trees during lightning. Isolated trees are more apt to be struck than a clump, and especially if they are near water. An oak tree by a pond is considered by electricians as offering a particularly unsafe position. In fact, water and damp ground are to be avoided, as well as trees. It would be safer to lie flat on the ground than to stand upright if the storm is immediately overhead, which can be ascertained by noting that the flashes and the reports are simultaneous. Indoors it is dangerous to sit near metal objects, such as mirrors, picture frames, and wire bell-pulls; but particularly near the fire, because the metal grate, the soot, and the column of heated gases in the chimney are likely to "draw" the discharge. A safe place is believed to be the middle of a room, especially in a room in the middle story of the house; but according to a recent lecture of Professor Rowland, of Baltimore, a distinguished physicist, the safest of all places is an iron (or metal) bedstead. Lying on this, one is in a kind of metal cage, which acts as a lightning screen.—*London Globe.*

The *New York Tribune* has the following rather sensational dispatch from San Francisco:

"There is something peculiar in the tactics of the managers of the Temescal tin mines in Southern California. The company is largely owned by English capitalists who have bought debenture bonds, and it is openly charged by those who have seen the recent operations at the mine that these English owners are trying to freeze out other stockholders and thus gain control. The work of production, which could be pushed at once, is delayed by various pretexts. The only explanation of this policy of failing to take advantage of the fine opportunity to produce tin is that pressure has been brought to bear on the English holders of the securities to shut down the mine so as to lessen the competition caused by the McKinley bill. San Bernardino County is rich in coal and iron, and the success of the Temescal tin mines would have led to the establishment of a tin-plate factory at San Diego as well as iron and steel works. All these factories would cut into English industries, and the easiest way to prevent it was to check the production of tin in California."

A woman in a telegraph office is almost as much out of her element as she is at a teller's window in a bank, or as a man is in a dry-goods store. A young lady of this town tried to send a telegram to a friend whom she expected to visit her this week, and on the blank wrote: "Come this week sure, and stay as long as you can." She carefully underscored the words she wanted emphasized and complacently handed in the message to the operator.—*Buffalo Courier.*

The above is probably true, and it is just about as true of the average man as it is of the average woman. "Please" and "truly," with other similar expressions, are not uncommon in the instance of telegrams indited by business men, though, of course, away out of place in business messages.

It begins to look as if the construction of the much-talked-of Hennepin Canal was to go on after a while, as proceedings for condemning land have been begun in the courts. Congress has authorized the construction of this canal, which is to connect the Illinois and Mississippi Rivers. The plans call for a channel eighty feet wide and seven feet deep.

Machinists' Supplies and Iron.

NEW YORK, September 5, 1891.

Iron—American Pig—There is a little more activity in the market, but prices are as yet unaffected by this, and sales continue at low figures.

We quote: Standard Northern brands, No. 1 Foundry, $16.75 to $18; No. 2, $15.50 to $16.50; Gray Forge at $13.90 to $15. Southern brands of good quality are quoted at $16 to $17.50 for No. 1 Foundry; and $15.75 to $16 for No. 2; and $14 to $14.50 for No. 3.

Scotch Pig—We quote Coltness at $23, Eglington, $20.50.

Copper—The market for Lake continues dull, and there are indications of a disposition to shade prices slightly from previous quotations, though prices are not regularly lower. Values for Lake are 12.30c. to 12.40c. Casting copper, 11¼c. to 11⅝c. Arizona Ingot, 12c.

Lead—Owing to a difference between buyers and sellers as to real values, business has been light. Values are nominal, and about 4.45c. to 4.55c. in car load lots.

Spelter—Transactions have taken place at 4.90c. in car load lots, and thus the actual value is fixed; something which had not been done before for some time. There is some indication of improved trade.

Tin—Not much has been done, and the speculative interest seems quiet. The foreign market is lower, and that, together with an increasing supply here, has a tendency to weaken prices. Quotations for spot are 20c.

Antimony—Prices are somewhat easier. We quote Hallett's, 10c.; Cookson's, 12c.; L. X., 10¾c.

Lard Oil—The market is steady at 54c. for Prime City; Western, 53c.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

An assistant draftsman having finished an engagement desires position. Box 53, AM. MACH.

Spanish correspondent desires position; formerly engaged in S. American trade; N. Y. refs. Address Correspondent, Ivor, Virginia.

Young Norwegian, graduate of technical college, and with some practical experience, wants position as draftsman. X. X., care AMERICAN MACHINIST.

Wanted—A position by technical graduate; opportunity for learning will be particularly considered. Box 50, AMERICAN MACHINIST.

Wanted—Position as foreman machinist by a man accustomed to heavy steam engine work and pumping machinery; good refs. Hancock, AM. MACH.

Wanted—Situation as foreman or assistant in an engine shop in city or near by. Address J. D. King, 443 West 32d street, N. Y.

Wanted—A first-class foundry foreman on printing press and general work. A young man preferred. Address, giving age, past and present employers, W. H. M., Box 235, Boston, Mass.

Wanted—Position as draftsman by a Swede with 10 years exp. in the drawing-room & one year in the machine shop; college graduate; A 1 refs.; "considerable inventive ability." H. L., AM. MACHINIST.

Wanted—Position as foreman or supt. by a young man at present foreman in a large western shop; practical machinist and draftsman of jigs, etc., for interchangeable work. Box 52, AM. MACHINIST.

Wanted—Superintendent for a machine shop employing about 300 men in the manufacture of small tools; good opportunity for a competent and progressive man. Address, stating age, experience, and salary expected, Box 47, AMERICAN MACHINIST.

Wanted—A position as supt. or foreman by a first-class mechanic; thoroughly understands model, die and tool making; has been connected with some of the finest work done in the country. Correspondence solicited, references exchanged. Address Box 51, AMERICAN MACHINIST.

Wanted—A pattern maker familiar with steam dredge work; one who can make working drawings, and is sober and reliable, to go to a town of 12,000 inhabitants in Northwestern Pennsylvania. Address, giving age, reference and price, "Dredge," AMERICAN MACHINIST.

Wanted—A good machinist who has had some experience as a traveling salesman, and who is willing to engage with reliable parties to travel a part or all of the time. Please state particulars in regard to past experience, give references, and state wages expected. Address Box 44, AMERICAN MACHINIST.

Wanted—A 1st-class foreman for a floor of 50 hands on medium and light work. Must have good judgment, executive ability, and be well posted in the modern methods of getting out work of a good grade economically. A good opening for the right man, who must be thoroughly competent. Address, with age, experience, and salary expected, Baltimore, care AMERICAN MACHINIST.

Wanted—A young graduate with a good theoretical knowledge of electricity and drafting, who would like to spend a year in applying his knowledge where there are good facilities for perfecting himself as a designer of electric machinery. Must have some natural talent, and enough theory for designing electric motors, etc. Salary small for first year. Address, with refs., Graduate, AM. MACH.

Wanted—At a machine shop near New York, employing about fifty men, a thoroughly competent foreman having immediate charge of men, who is willing to carry out ideas, methods and orders given him, in as thorough and conscientious manner as he would do if they originated with himself; one methodical in his habits, and thoroughly acquainted with, and capable of administering efficient shop discipline, to the end that the work turned out will be done skillfully and economically. A man with technical education or some training in technical school or its equivalent preferred; state age, experience, and salary required. A. B. C., AM. MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Wanted—Novelties to build. McNair Tool Company, Meadville, Pa.

Working drawings of machinery and plans of mills drawn. Address Box 40, AMERICAN MACHINIST.

Special leather and cement for covering pulleys; no rivets required; local agents wanted. Crescent Mfg. Company, Cleveland, Ohio.

Fine Automatic Machy. Punch, Die & Screw Mach. Work Specialities. Send sample for low estimates. Novelty Mach. Works, Orange, N. J. P. O. Box 434.

For Sale Cheap or Exchange—Eleven right and left modern Patent Automatic Cut-off Engine Patterns & Drawings, from 10" to 20". B 9, AM. MACH.

For Sale—Three 3-ton jib cranes, 20 feet height of mast, swing in space of 35 feet. Apply to The J. Morton Poole Company, Wilmington, Delaware.

Wanted—Agents for the Machinists' Hand-book on lathe screw cutting, figuring speed, setting valves, etc., etc. Price 50 cts. Loetzer & Bynon, Sayre, Pa.

Machine shop and boiler shop, with all necessary tools, for sale or rent; located at West Point, Pa., twenty-four miles from Philadelphia. For particulars address D. C. Wismer, Quakertown, Pa.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

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SMOOTH · COLD DRAWN
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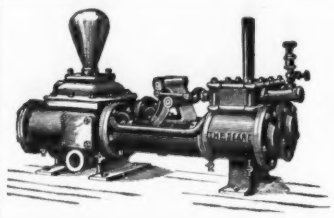

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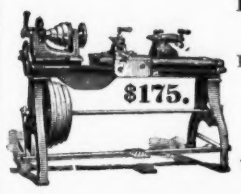

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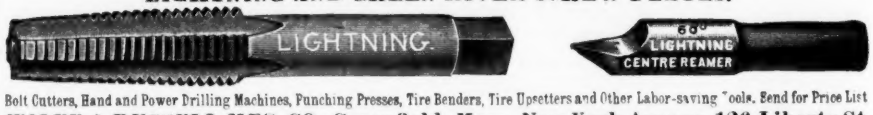

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How to get the best results with "R. MUSHET'S SPECIAL STEEL." Greatly increase your speeds and feeds then compare the work you turn off with that done by any other known Steel This will make the first cost of "Mushet's" look insignificant.
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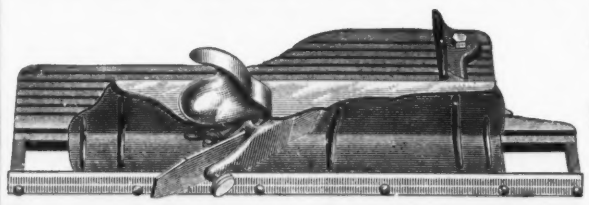

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Samples and Descriptive Price List Free by Mail.
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
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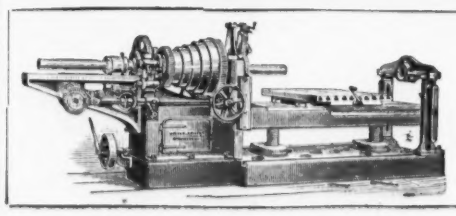

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IMPROVED PATTERNS! LATE DESIGNS!

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Men test everything in this world by what it produces.
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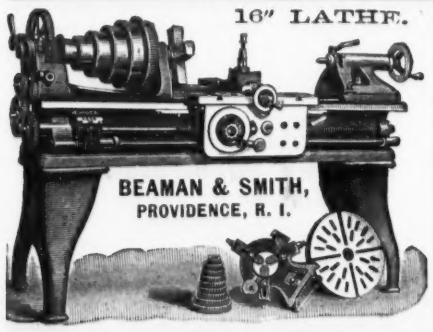

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In perfect condition. Can be seen running till about Oct. 15, when it will be replaced by a larger engine. Size 14x42, 85 h. p., with 80 lbs. steam. NEWELL BROS. MFG. CO., Springfield, Mass.

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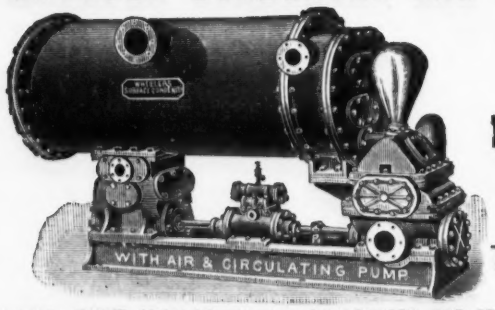

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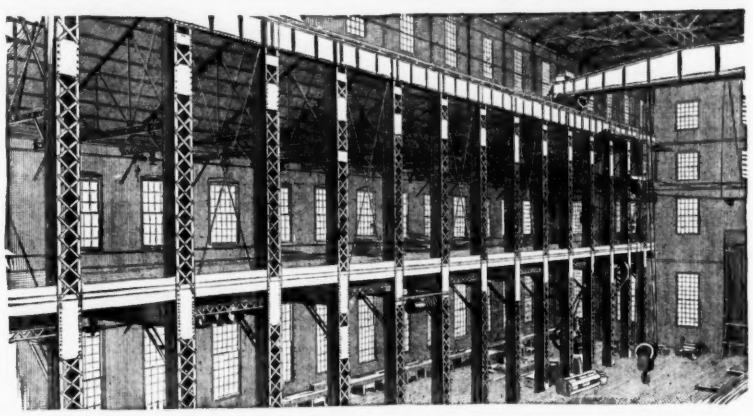

The above illustration shows an interior view of the Machine Shop designed and built by us for the Newport News Ship Building & Dry Dock Co., at Newport News, Va. The photograph was taken looking diagonally across the Machine Shop into the gallery floor, and shows the first and second floors in the lean-to and the traveling crane in the main portion of the Machine Shop. The building is 100 ft. in width by 300 ft. in length, the central portion being 50 ft. in width, two stories high, with a wing on each side 25 ft. in width. The floor space in the central portion of the building is served by a hydraulic crane as shown in the illustration.

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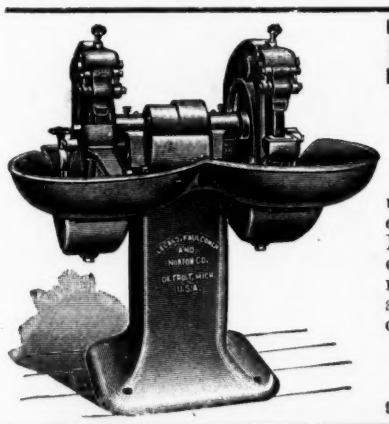

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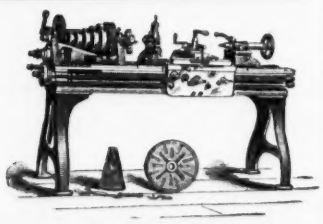

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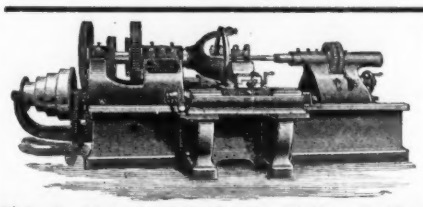

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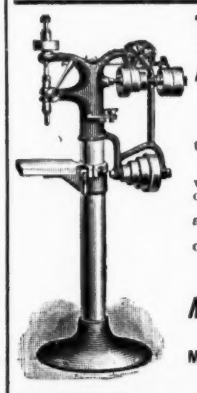

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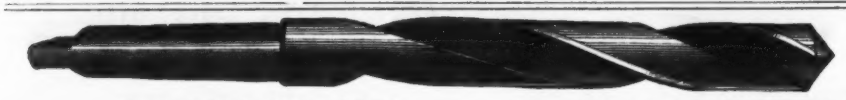

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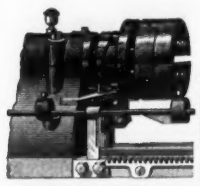

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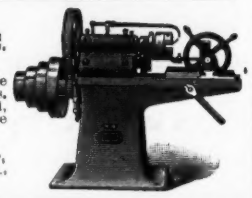

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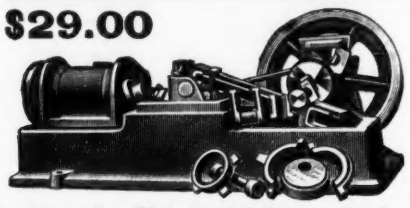

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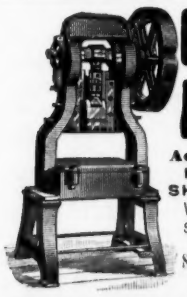

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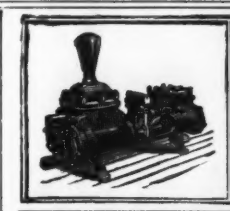

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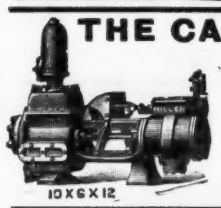

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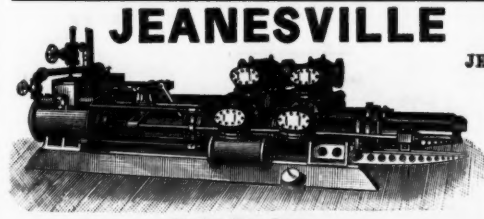

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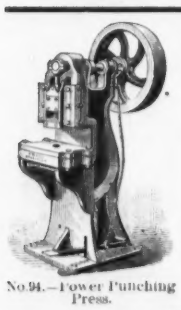

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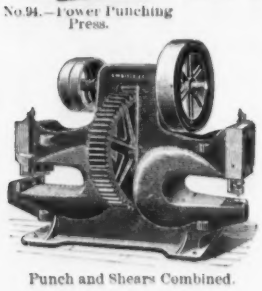

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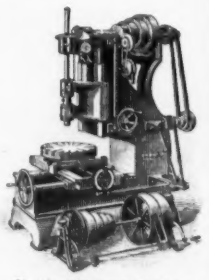

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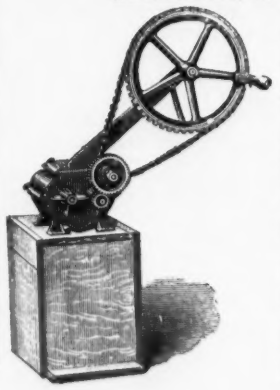

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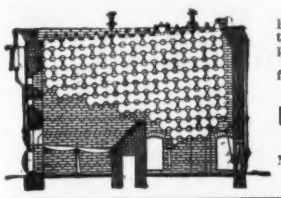

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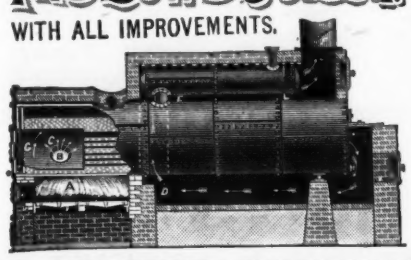

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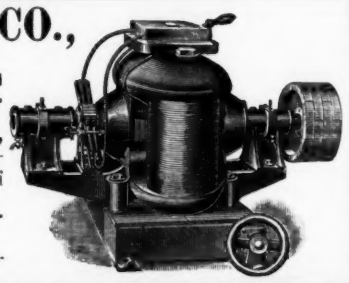

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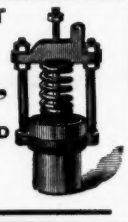

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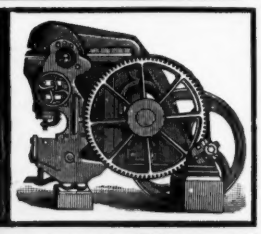

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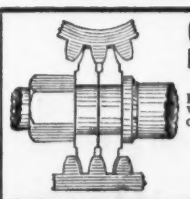

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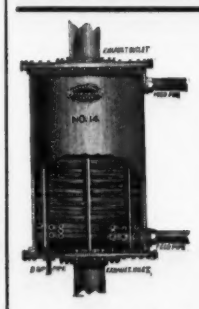

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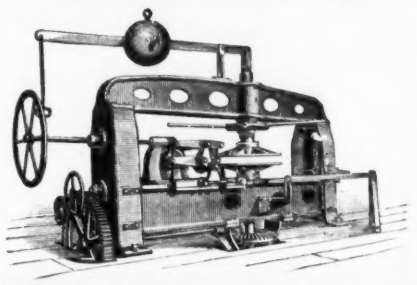

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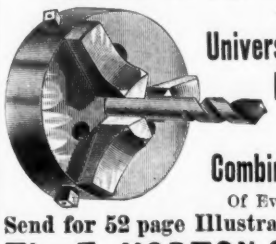

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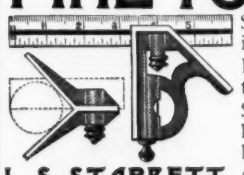

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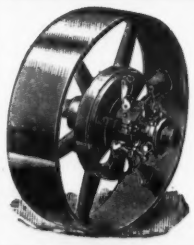

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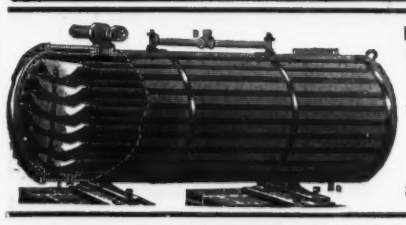

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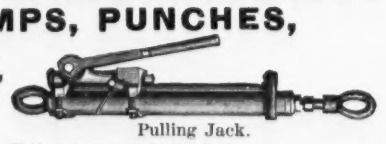

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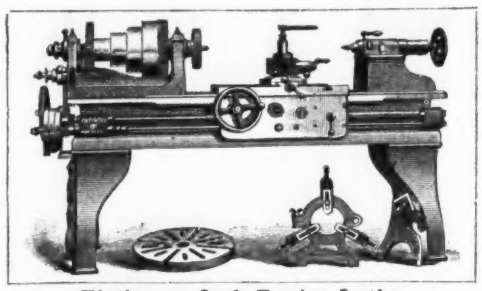

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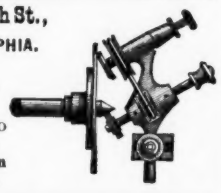

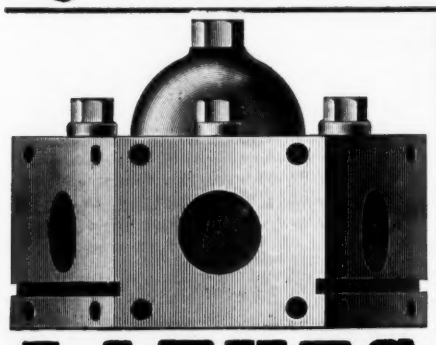

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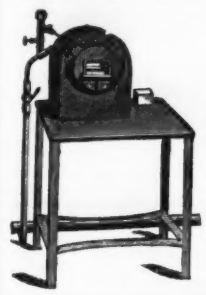

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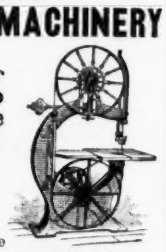

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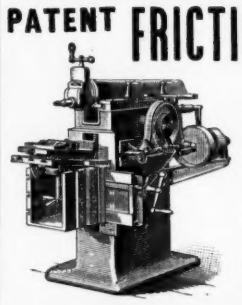

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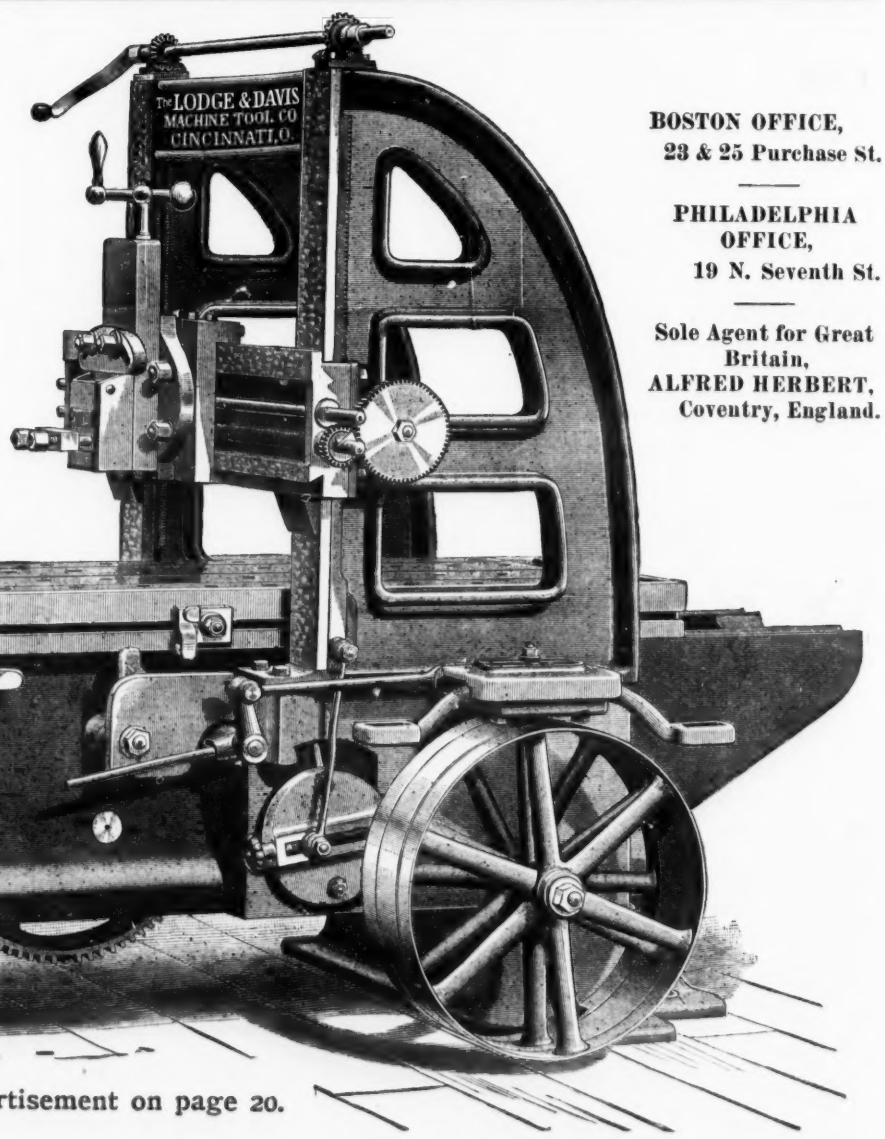

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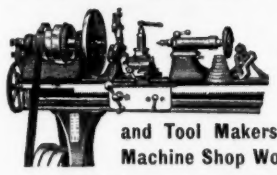

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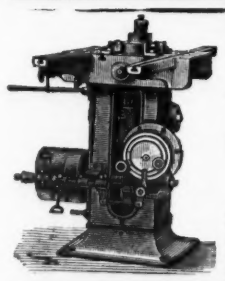

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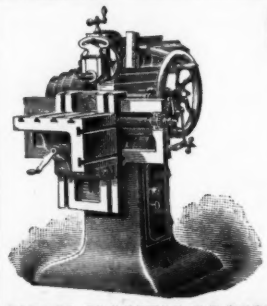

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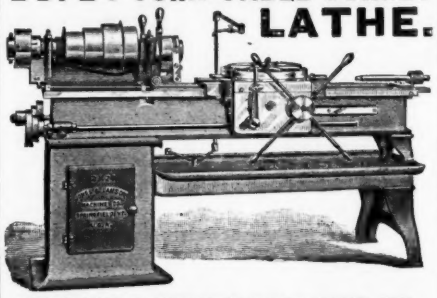

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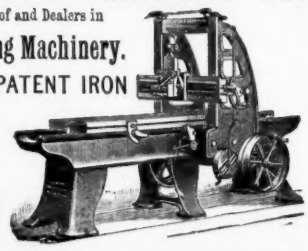

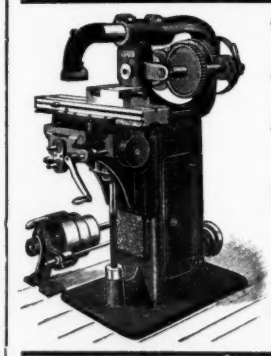

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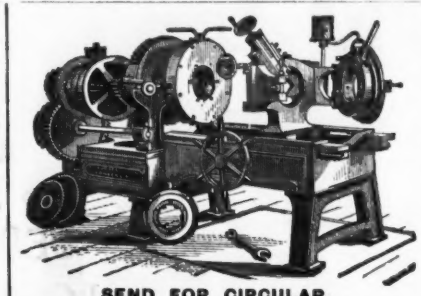

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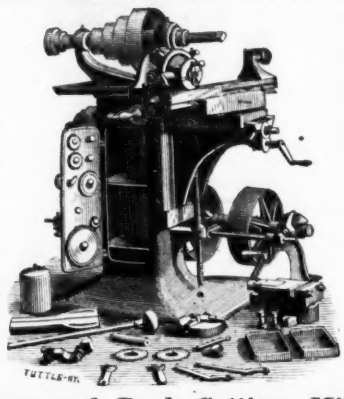

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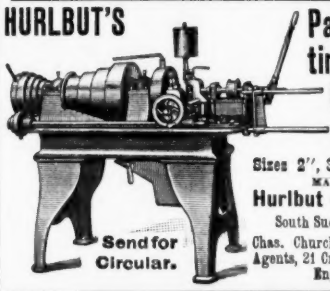

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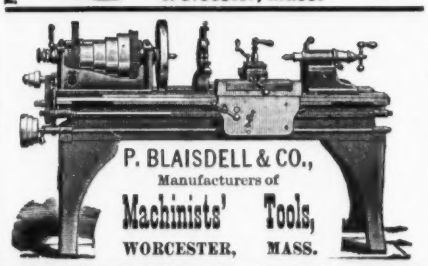

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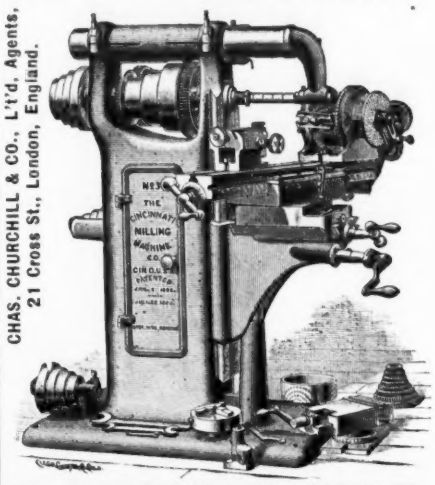

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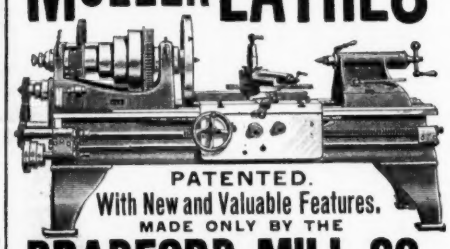

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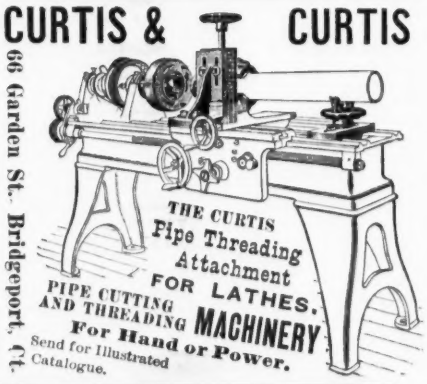

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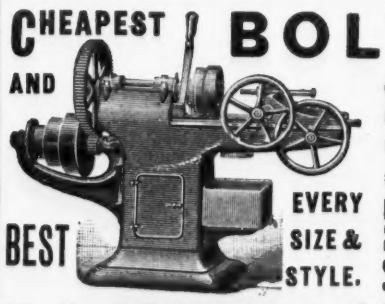

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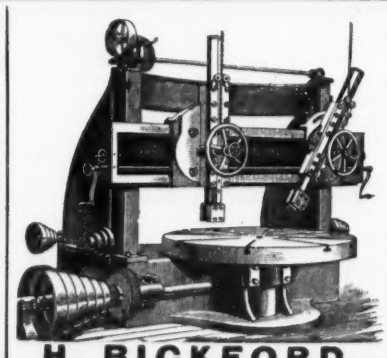

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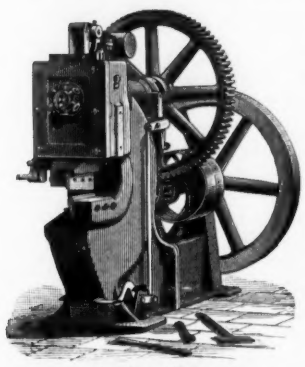
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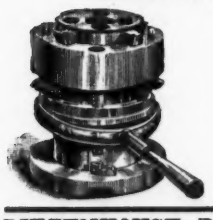
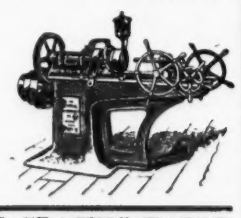

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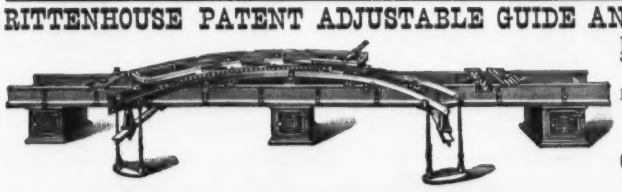
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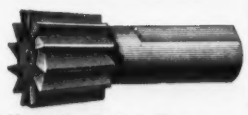

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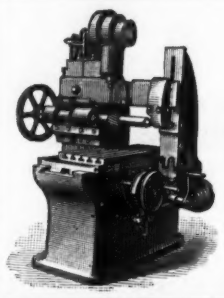
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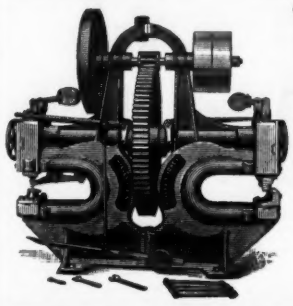
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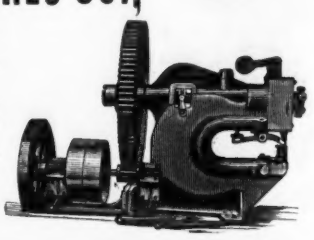

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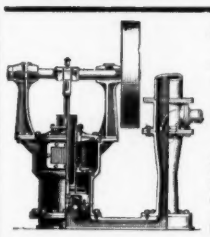
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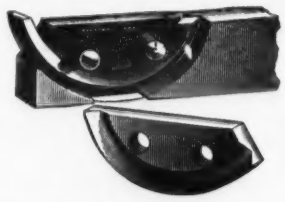
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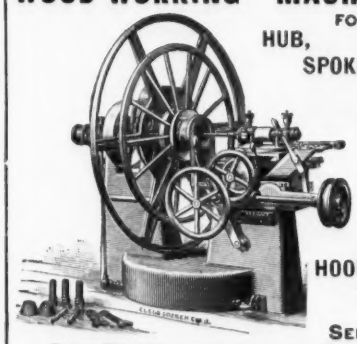
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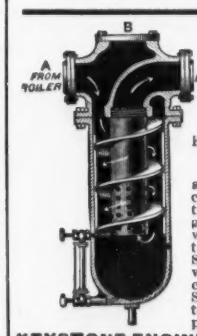

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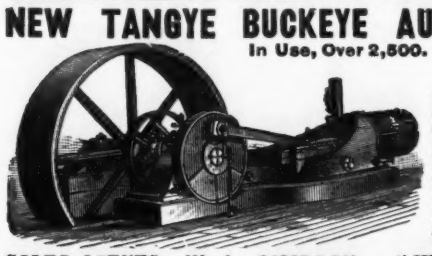

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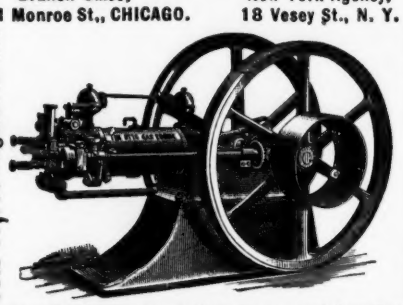

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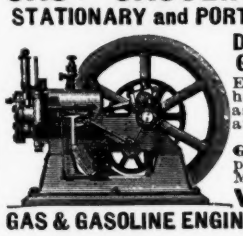

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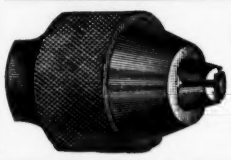

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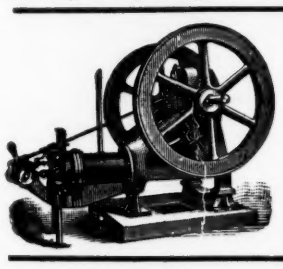

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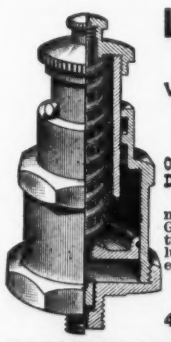

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"	25 in. x 12 ft.,	New Haven,	" "
"	24 in. x 12 ft.,	Fitchburg.	
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"	18 in. x 8 ft.,	Fitchburg.	
"	18 in. x 6-8-10 ft.,	Hendey, Plain & Taper Att	
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"	16 in. x 6 8 10 ft.,	Fitchburg, Plain & Taper Atts. Compound Rests.	
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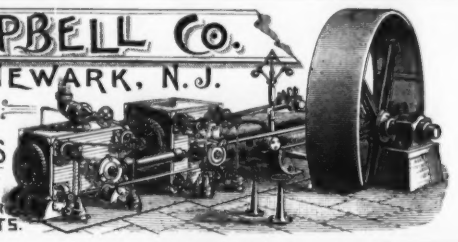

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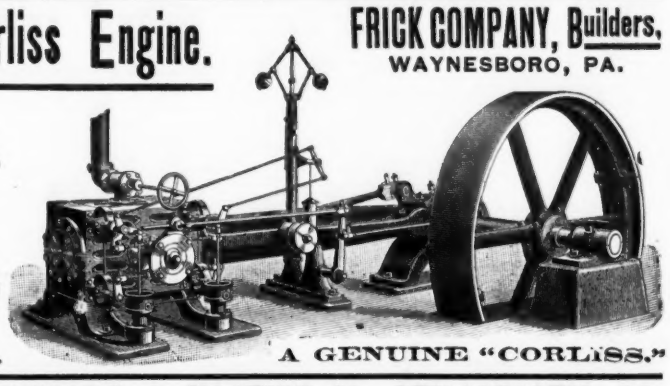

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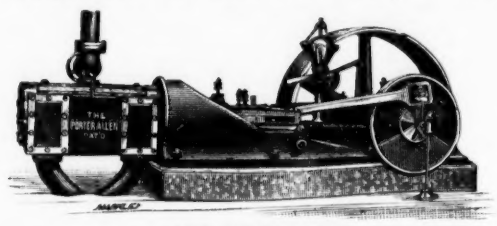

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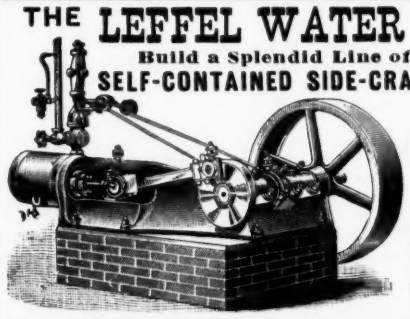

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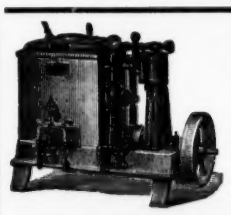

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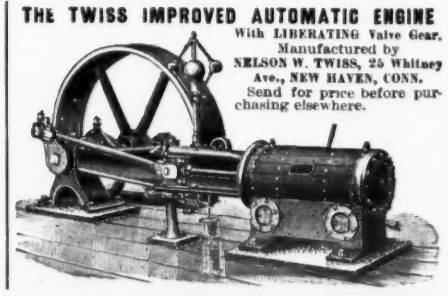

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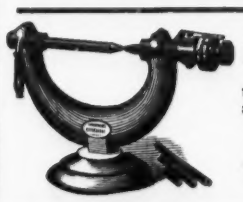

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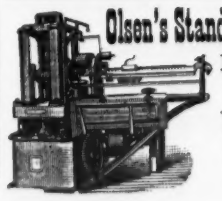

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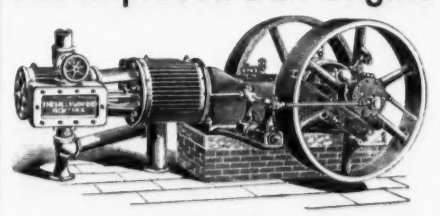

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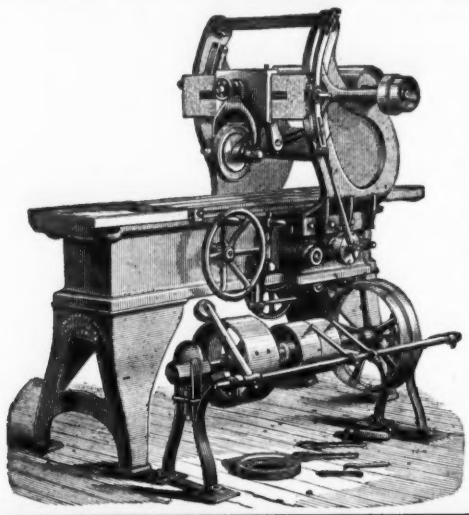

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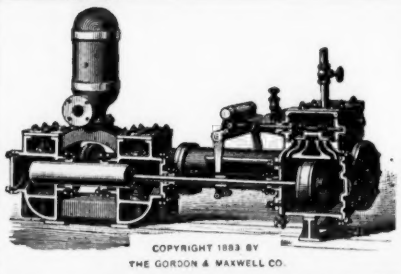

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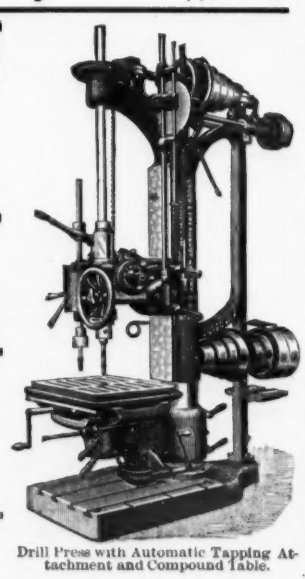

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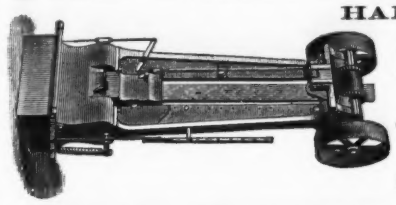

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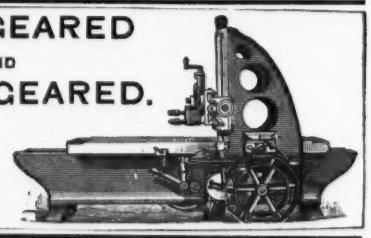

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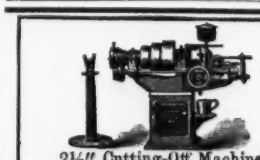

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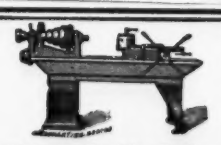
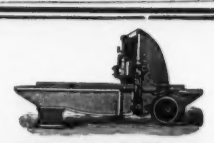


20" × 6' Chucking Lathe.



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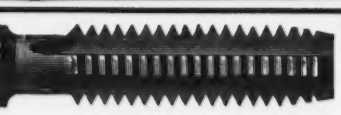

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